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EMINENT DOMAIN FOR POWER TRANSMISSION.

An important series of hearings has recently been held before the Massachusetts Gas and Electric Light Commission regarding the granting of the right of eminent domain for electrical transmission and supply companies. The right of eminent domain is one which has been already granted to power transmission and similar companies in several States, but as a rule such cases have involved somewhat different issues from the present one, in that they mostly have been in regions less densely settled and with fewer local supply companies than in Massachusetts. The work of transmission companies in that State, and generally in communities well populated, has tended more and more to become a wholesale proposition, the energy generated not being distributed by the generating company save to local electrical supply companies and to factories using power in large blocks. A tentative bill submitted to the commission seems a praiseworthy endeavor to straighten out the situation for cases of this kind. It permits granting a certificate of exigency under which the line may be located and built, the municipal authorities retaining the right to specify the locations and construction along the route in their respective domains, with the proviso that the route laid out may not be along any public way without the consent of the local authorities. Further, it is proposed to give the electrical companies the right of eminent domain for cases in which the exercise of that right may be necessary. The provisions of the proposed bill apply both to transmission companies and to electrical supply companies, and there is a restriction that the transmission companies may not sell their electricity in any municipality through which their lines pass without special authorization to this effect by the authorities. In case of dispute there is the opportunity for an appeal to the commission.

If such a bill as this is enacted into law it will certainly encourage the growth of electrical transmission in Massachusetts. The claim was strongly made by the representatives of the various companies concerned that the rights proposed to be given would tend to reduce the cost of energy to consumers on account of lessening the necessary costs of construction which now have to be faced in the absence of any right of eminent domain. One of the counsel for companies interested emphasized especially that the commission ought not to take any steps toward recommending eminent domain unless on the ground that lower rates to the consumer would result. Just at this point there arose an interesting question. How can transmission companies which have no permission to sell electricity except in bulk reduce charges to the ultimate consumer who is supplied through another company? Doubtless the tendency to lowering the cost of electrical energy to the distributing companies would lead toward this result, but in the discussion a point was very well taken that the right of eminent domain could hardly be granted to private persons or

corporations not concerned with public use of the service; and that if a man's land is taken and he is unable to avail himself of the electrical energy transmitted except through an intermediary to whom the transmitting company is not responsible there is question as to the constitutionality of the act. In other words, is there any equitable reason for granting eminent domain for supposedly public service corporations which are really restricted in their sales to a limited number of other corporations and cannot reach the general consumer? Such an objection would not lie against granting eminent domain to bona fide distributing companies standing ready to serve any customer in the territory covered by their lines. In point of fact, such distributing companies work largely along the public ways, and the granting of eminent domain to them is only important in case of the great consolidated plants that stretch out over a large expanse of territory previously served by small independent corporations. For such cases the granting of eminent domain affects directly the needs of the territory served.

The situation is a curious one brought about by the rapidly growing tendency of transmission companies to sell in bulk only, in order to avoid the friction and expense which necessarily arise from establishing distributing lines in territory already occupied, even supposing that rights for such work are legally obtainable. Nevertheless, it would seem to be the larger view of the subject that power transmission companies, which on the whole tend to lessen the cost of electrical energy, should be encouraged and should not be liable to obstruction on the part of avaricious or unreasonable citizens. There is a strong tendency toward the use of private rights of way by transmission companies owing to the more complete control over the lines thus obtained, and in part to a somewhat ill-grounded fear on the part of the public that danger may arise from transmission lines along public ways. Granted that on account of these sentiments and expediency generally transmission lines should preferably acquire private rights of way, it certainly seems that it is the business of the State authorities to facilitate this admittedly desirable end by granting the right of eminent domain even although the connection between the ultimate consumer and the transmission company is not a direct one.

Without such a right it would be possible for one company by purchase of a strip of land across the proposed line of another to force the latter into a long deflection not only inconvenient and unnecessary, but ultimately expensive to the consumer; and it would certainly seem unreasonable to draw a line between the transmission company that sells power to a central station and the transmission department of the latter, which is occupied in filling precisely the same mission. No constitutional question could well be raised concerning the propriety of granting eminent domain to a public service corporation which did its own transmission. And since the power transmission companies acting independently accomplish the same result, sometimes more economically, there seems to be no sound reason for ruling against their participating in the benefits of eminent domain. We know of no case in which such rights granted the transmission companies have worked badly from the standpoint of the public interest. On the contrary, they have greatly facilitated improvements, which in the long run cannot fail to be a public benefit.

ILLUMINATION AND THE EYE.

A valuable paper on this subject abstracted in a foreign contemporary was read by Dr. Broca before the second Congrès International des Maladies Professionelles recently held in Brussels. It follows much the same line as the important paper by Broca and Laporte published two years ago, and deals especially with questions of brightness in relation to pupilary aperture and acuteness of vision. It is only recently that the effect of bright lights on pupilary aperture, and hence secondarily on ability to see by them, has received much attention. Pupilary aperture is a peculiarly difficult and unsatisfactory thing with which to experiment, inasmuch as the pupil is in constant slight activity and responds to psychological as well as physiological stimuli. Until within a few years ago the only data on the subject were those published more than a century ago by Lambert. Broca lays particular stress upon the effect of bright lights in the field of view on the visibility of objects in the same field, and his results show that brilliant lights may easily reduce the aperture of the pupil to a point that utilizes only 20 per cent or 30 per cent of the effective light. The full text of his paper not being at hand, it is impossible to say at what angle to the line of fixation the lights with which he experimented were placed, a matter which is evidently important both on account of the effect on the position of the bright image on the retina as influencing its light sensitiveness and also by reason of the fact that the pupil reacts differently to bright stimuli on different parts of the retina. The difference produced by bright light also depends greatly on the absolute amount of light energy that reaches the eye. Taking all these things into consideration, it seems likely that Dr. Broca rather understates than overstates the loss of efficiency due to pupilary reaction when a bright light is in the field.

He also touches on a very important phase of the matter—the difference due to the actual size of the image of the bright light upon the retina. When this image is so small as to fall within the area occupied by a single cone it is almost self-evident that the effect of lights of the same total intensity will remain the same irrespective of their intrinsic brilliancies. This fact was pointed out by Charpentier years ago, although Charpentier found that this condition was reached considerably before the image actually fell to the size of a single cone. From his experiments it would appear that the critical size of the image was at least a full tenth of a millimeter in diameter and probably more. Two conditions are therefore found with respect to bright lights in the field of view, one in which the intrinsic brilliancy of the source plays a very important part, the other in which it does not. The latter condition corresponds fortunately to that of relatively distant lights, in which case the total energy falling upon the eye is very much reduced, so that for most purposes of illumination the former condition, in which intrinsic brilliancy is a matter of considerable importance, is the common one. One of Dr. Broca's important practical conclusions is that the ordinary artificial illumination is not strong enough, on the ground that while it may be quite sufficient for reading or other work at ordinary distances from the eye it does not permit sufficient ease of vision of details at greater distances. He suggests that the illumination should be approximately three or four ft.-candles while reading or similar work is going on. His figures are quite in keeping with previously published data on the subject, which indicate that

the eye works excellently well for reading and similar purposes when the light available at the object viewed is two ft.-candles, or even less. This smaller quantity divided by the coefficient of reflection brings up the illumination desirable reckoned at its incidence upon the object to approximately Dr. Broca's figures.

POTENTIAL STRESSES IN DIELECTRICS.

The paper read by Messrs. Harold S. Osborne and Harold Pender at the last meeting of the American Institute of Electrical Engineers contains some important features in relation to the design and use of high-tension cable conductors. If two large circular metallic disks are mounted parallel and facing each other in such a manner as to be capable of connection to the terminals of a suitable high-tension source, it is known that the electric field between the plates is uniform at all points not too near the edges. That is, the electric flux distribution is everywhere in parallel straight lines perpendicularly across the space between the plates. Under such conditions the voltage that the gap can sustain, whether the gap is composed of gaseous, liquid or solid material, is found to be sensibly in direct proportion to the gap widths, so that if an air-gap of 1 cm takes a continuous potential difference of 40 kilovolts to produce puncture, a gap of 2 cm will take 80 kilovolts, and so on. This may be described by saying that air, under the particular pressure and temperature considered, withstands an electric intensity of 40 kv per centimeter, or 4 kv per millimeter. This statement may be further simplified by saying that the dielectric strength of the air is 4 kv per millimeter. In general, the dielectric strength of good solid insulators is greater than that of good liquid insulators, which, in turn, is greater than that of good gaseous insulators. Thus rubber has a strength of about 14 kv per millimeter, oil 8 kv per millimeter, and air, at ordinary pressures and temperatures, about 4 kv per millimeter.

When a dielectric is tested between two metallic surfaces that are not parallel plates the behavior of the substance in regard to electric disruption is much more complex than the above. Thus, to take a comparatively simple case for practice, a copper wire 1 mm in diameter is covered with an insulating material to a total diameter of 5 mm and then lead-covered to an outside diameter of 7 mm. Suppose the dielectric strength of the insulation is 8 kv per millimeter. Then, since the wall of insulator separating the copper wire from the lead sheath is everywhere 2 mm thick, it might be supposed, at first sight, that the insulation would withstand 16 kv continuous e.m.f. between wire and sheath. Experiment shows, however, that it will not stand more than about 7 kv. The explanation for the apparent weakness of the insulating layer on the wire is that the field of electric force to which it is subjected is not a uniform parallel field, like that between two large flat plates, but is a field that radiates from the surface of the wire. In any such divergent field the intensity increases with the density of the flux, so that the volts per millimeter are greater at the surface of the wire than at the inner surface of the sheath. When the continuous e.m.f. applied between the wire and sheath, across the 2-mm wall of insulation, is 7 kv with an apparent average intensity of 3.5 kv per millimeter, the maximum intensity—at the wire surface—is about 8 kv per millimeter and the minimum intensity—at the sheath surface—is only 1.6 kv per millimeter. Consequently, the inner layers of the insulation are being strained to the rupture point, while the outer layers are in easy circumstances.

By applying a plurality of layers with materials of successively diminishing inductive capacity the dielectric stresses on the different layers will be made more nearly uniform, and the insulation will be worked more nearly up to its proper strength with greater economy of material. Such graded cables are already in service to some extent and their behavior has justified the above course of reasoning. There are, however, certain complicating influences to be taken into account, especially the influences of heating and of moisture. The subjection of a dielectric layer to alternating electric stress produces a certain amount of heat therein by electric hysteresis akin to the heat hysterically produced in iron by alternating magnetic stress. This heat generated in the dielectric, together with the heat produced in the wire by the load current, raises the temperature of the dielectric and reduces its dielectric strength. Unless kept cool the insulating coating may thus soon weaken sufficiently to be ruptured by a very moderate electric intensity. Moreover, moisture, or even air, occluded between successive layers of a graded cable, may readily cause break-down under alternating electric stress in such a manner as to extend the rupture into the neighboring layers and so undo the benefit of the grading.

The paper here considered extends the theory of the subject by giving formulas and curves for finding the total electric strength of a graded cable, and also for finding the most economical distribution of the layers. The original rule had been, make the specific inductive capacity of each layer inversely proportional to the radius of the layer. The new rule is, make the product of the dielectric strength and inductive capacity of each layer inversely proportional to the radius of the layer, if every layer is to be worked to the same factor of safety. The bad effects of occluding an air layer between two layers of a graded cable was made evident by the authors by an experiment in which a piece of rubber-covered wire was drawn into a glass tube. By applying an alternating voltage to the combination the rubber gave way not as a whole but in spots, so that the stress was delivered to the outside glass tube unevenly and destructively. The experiment indicates that in certain cases where powerful alternating electric stresses have to be withstood it may be advantageous to insert tinfoil between the successive layers. If one layer then breaks down, the next, at least, will be likely to receive the stress uniformly.

The advantage possessed by fluid insulating substances, that they are automatically capable of healing any puncture that may be made in them by overvoltage, compensates in considerable measure for their lower dielectric strengths. It is to be remembered that there are now transmission circuits operating industrially at 100 kv and experimentally at 150 kv, using air insulation between overhead wires, whereas very little cable is used at pressures above 20 kv and none above 50 kv. The above great disparity between the present possibilities of high-voltage insulation in aerial versus cable conductors makes the commercial disparity appear still greater. Any resource which will increase the dielectric strength or reduce the cost of cable conductors is to be welcomed greatly in the present state of the art's development. The judicious grading of cables is certainly likely to help, but the most nearly perfect grading must fall far short of existing needs.

Baltimore Convention of Illuminating Engineering Society.

The social portion of the program for the coming annual convention of the Illuminating Engineering Society at Baltimore has been designed to bridge the interval between the meetings of the convention and the opening of the course of lectures on illuminating engineering to be held at the Johns Hopkins University.

On Tuesday evening, Oct. 25, will be held the annual banquet of the society, to which will be invited all in attendance at the course of lectures. President Remsen, of the Johns Hopkins University, and Dr. Hyde, president of the Illuminating Engineering Society, as well as many other speakers of note, will address the gathering. Invitations have been extended by the officers of the society to the following organizations to be represented at this occasion:

American Institute of Electrical Engineers, American Gas Institute, National Electric Light Association, American Institute of Architects, American Ophthalmological Society, Academy of Ophthalmology and Oto-laryngology, International Acetylene Association, National Commercial Gas Association and Association of Electric Railway Engineers.

The attendance at the Johns Hopkins lectures promises to reach 150. While no time has been fixed for closing the attendance list, the authorities of the university are desirous that applications should not be delayed beyond the present week in order that proper classroom and laboratory arrangements may be made to accommodate those taking the course.

Standard Electrical Rules for Mines.

The National Bureau of Standards has issued a circular (No. 23) entitled "Standardization of Electrical Practice in Mines," which forms a valuable contribution to the subject of the safe use of electricity in mining.

In an introduction a history is given of the movement which led to the publication of the present work. At a meeting of the American Mining Congress in Denver, Col., in 1909 a committee of seven members was appointed to report on the subject of the standardization of electrical practice in mining work, the membership consisting of one electrical engineer, two representatives of electrical manufacturers, two representatives of mine operators and two representatives of mine workers. Dr E. B. Rosa, of the Bureau of Standards, was selected as the electrical engineer, and one member from the staff of the General Electric Company and one from the Westinghouse Electric & Manufacturing Company represented the electrical manufacturers. As it became necessary for the Bureau of Standards to do a much larger share of the work than was at first contemplated, Mr. Burton McCullom, of the bureau, was detailed to assist Dr. Rosa, who was appointed chairman of the committee. A preliminary report of the committee was made Sept. 20, 1909, and a special meeting of its members was to be called for January, 1910, when it was learned indirectly that at the Goldfield meeting of the American Mining Congress the committee had been dismissed and the president authorized to appoint a new committee. It appears that there was opposition from some mine operators against the work which the original committee had undertaken. They believed that the mine owners and operators could safely be left to themselves without any limitation or supervision, such as would be entailed if the proposed standardization of electrical practice were made the subject of state legislation. The chairman of the new committee appointed stated that he did not intend to take up the work the original committee had commenced. In view of the considerable work already done along the original lines, it was finally decided that the bureau should carry on the work to completion and publish the results. The bureau invites criticism and suggestions concerning the rules submitted in the circular, in order that they may be improved as much as possible in the next edition, which will be carefully revised. In continuation of the work the bureau will have the co-operation of the Bureau of Mines, which has recently been established and which will continue the experimental work begun in the technological branch of the Geological Survey relative to the use of electrical apparatus in explosive atmospheres.

The proposed rules for the installation of electricity in mines number fifty-four, and there is an additional section on the inspection of the electric equipment of mines, and on the dangers of electric wires and how to avoid them. There is also a section containing explanatory statements applying to a number of proposed rules on which there appears to be considerable diversity of opinion, and an appendix of fifty-one pages giving a compilation of the electrical mining laws of the different States that have done anything in this direction, and of the principal foreign countries.

These rules are classified under the heads of Definitions; General; Transmission Lines and Cables; Switches, Fuses and Circuit-Breakers; Motors; Special Rules Governing the Use of Electricity in Gaseous Mines. A further section on the inspection of the electrical equipment of mines gives the form of an act providing for the appointment of an examining board for electrical mine inspectors, describing the nature of examinations, the salaries and the duties of electrical inspectors, etc.

The rules are in such detail that only a few can here be noticed. Electrical mining systems are defined with respect to voltage as low pressure, not exceeding 300 volts; medium pressure, between 300 volts and 600 volts, and high pressure, exceeding 600 volts. Under the head of "General" are rules prescribing the grounding of machine frames and electric circuits, and prohibiting the use of voltages above 600 for portable motors and other purposes underground except for alternating-current transmission or for application to alternating-current apparatus in which the high-pressure circuit is stationary. It is further provided that all transformers in the latter case shall be of the oil-insulated type, and that no motor shall have a normal rating less than 20 hp.

One of the rules requires that in every mine where electricity is used below ground a competent mine electrician, and where necessary an assistant mine electrician also, shall be employed, who shall have full charge of the electrical apparatus used in connection with the mine. A requirement is that instructions shall be placed at the mine entrance and in every generator, transformer and motor house for the resuscitation of persons suffering from electric shock, and all employees operating electrical apparatus shall be required to acquaint themselves with these instructions. The insulation of conductors and the installation of circuits are closely covered, as well as the details of electric haulage installations. The work reflects great credit on the bureau and should do much in furthering the application of electricity to mining by removing grounds for criticism based upon the slipshod manner in which many electrical mine plants have been installed or left without competent supervision and inspection.

Annual Convention of Illinois State Electric Association.

The officers of the Illinois State Electric Association with the co-operation of the Illinois Electrical Exhibitors' Association are endeavoring to make the coming annual meeting of the association at Rock Island, Oct. 25-27, the most successful in the history of the organization.

President McKinley, of the Illinois Traction System, has placed at the disposal of the executive committee a special car for the convenience of those whose plants are near the traction company's line. This car will leave the Illinois Traction System's station, Twelfth Street and Lucas Avenue, St. Louis, at 6:45 on the morning of Oct. 25, reaching Peoria at 1:40 p. m., from which point the members will take a train over the Rock Island road to Rock Island. A special time card has been issued for this car and a copy sent to those operating central stations in the southern and eastern part of Illinois, giving the time of its departure from various stations along the line. A lunch will be served on the car.

The program begins with a smoker, vaudeville and "get to-

gether" meeting at 8:30 p. m., Tuesday, Oct. 25, at the Elks' Club Room. At this smoker the members of the association will be the guests of the supply men.

Wednesday, Oct. 26, has been designated "New Business Day." After the report of committees and other routine business, the first paper will be *Signs and Window Lighting,* by Mr. E. W. Osborn, advertising manager of the Rockford Electric Company. After this will be a paper on *The Radical Tendency in Rates,* by Mr. J. S. Maltman, new-business manager of the Kankakee Gas & Electric Company. The next paper, concluding the morning session, will be *Electric Shows in the Smaller Cities,* by Mr. J. E. Johnson, general superintendent of the Danville Railway and Light Company. The first paper at the afternoon session will be *Promoting New Business,* by Mr. T. P. Pinkard, new-business manager of the Peoria Gas & Electric Company, followed by a paper on *How to Get New Business,* by Mr. Max Heiliger, assistant manager of the Rockford Electric Company. The concluding paper of the day's program will be *New-Business Ideas,* by Mr. O. C. Macy, superintendent of the Alton Gas & Electric Company. In the evening the members of the association will be the guests of the salesmen at a theater party in the Illinois Theater.

The morning session of Thursday, Oct. 27, will be opened with a paper entitled *Des Moines Plan of Meter Reading,* by Mr. P. B. Sawyer, general manager of the Des Moines Electric Company, followed by a lecture on *Hunting of Synchronous Apparatus,* by Dr. E. J. Berg, professor of electrical engineering, University of Illinois. The session will close with a paper on *Publicity and Public Policy,* by Mr. C. W. Lee, secretary and treasurer of the C. W. Lee Company, New York. At 2 p. m. the executive meeting and election of officers will be held, after which a trip will be taken over the Tri-Cities railway in a special car. The People's Power Company will be the hosts at a banquet for the association in the "Black Hawk Watch Tower."

The following firms will have exhibits in a special room set aside for that purpose: Fairbanks, Morse Company, Dearborn Drug & Chemical Company, Wagner Electric Manufacturing Company, Tri-City Electric Company, Electric Appliance Company, Central Electric Company, General Electric Company, Ft. Wayne Electric Company, Johns-Manville Company, Westinghouse Electric & Manufacturing Company, Valentine-Clark Company, W. R. Garton Company, Simplex Company, Western Electric Company, Hughes Electric Company, Holophane Company, W. N. Matthews & Brother.

The People's Power Company will extend an invitation to the citizens of Rock Island, Ill., Moline, Ill., and Davenport Ia., to attend, free of charge, the electrical display.

Hydroelectric Energy Advocated for All Municipal Requirements in Chicago.

President R. R. McCormick, president of the board of trustees of the Sanitary District of Chicago, believes that all the municipal bodies in Cook County will do well to meet their power requirements of whatever nature by buying electrical energy, generated by means of the water-power of the Drainage Canal, from the Sanitary District. The City of Chicago secures all the electricity used for street lighting at the present time from this source, and is arranging to take nearly double the amount at present consumed. In addition, the new city hall and county building is to be supplied with electrical energy by the Sanitary District at the low rate of 1¼ cents per kw-hour. The District also sells electricity to some of the park boards and for some other municipal purposes. Mr. McCormick, however, contends that inasmuch as the Sanitary District is in itself a municipal corporation, the Drainage Canal being built and utilized by the taxpayers' money, the various other public utilities requiring power should avail themselves of this cheap supply. In particular he advocates the operation of the waterworks pumping stations by the use of electrical energy from the Drainage Canal, with perhaps steam reserves as a standby. One objection to this, however, has been that as the transmission line is thirty miles long, it would be dangerous to place sole reliance in it for power in case of a great fire.

Mr. McCormick also thinks that such bodies as the library board, school board, Cook County Hospital, Detention Hospital and other public institutions in Chicago, as well as the cities of Evanston, Oak Park and other smaller communities in Cook County outside of Chicago, should utilize the cheap electricity of the Sanitary District.

At a public hearing of the Merriam Commission to improve municipal service, held on Oct. 14, Mr. McCormick pointed out the extravagance of a number of plants for various municipal services. He cited the report of Sargent & Lundy to the Illinois Manufacturers' Association to show that the cost of pumping the city's water by steam is 0.5 cent per 1000 gal. On the basis of electrically driven pumps, with energy purchased at $26.40 per kilowatt per year, Mr. McCormick estimates that the cost of pumping would be reduced to about 0.3 cent per 1000 gal. This is figured on the entire separation of the waterworks buildings from the electrical pumping stations. By combining the two in one building, as might perhaps be done, a further economy could be effected.

During his address Mr. McCormick made the interesting statement that the Sanitary District made its bid for lighting the City Hall at the rate of 1¼ cents per kw-hour, with the knowledge that it would be required to spend $150,000 for the transmission lines and other investment required. One-half of this, he said, was for a storage battery which will be sufficiently large to carry the building load for two hours if necessary.

The use of electricity was advocated for the operation of the pumping stations used in sewage disposal, and the speaker also thought that Sanitary District energy might be used in lighting police and fire department stations. The speaker also made the interesting statement that all new substations of the Sanitary District of Chicago will be located in or near the pumping stations of the city water works, as far as practicable.

Meeting of the Brooklyn Company Section of the N. E. L. A.

The Brooklyn Company Section of the National Electric Light Association began its work for the season with a social meeting in Johnston Building on Oct. 3. The chairman, Mr. E. A. Baily, in addressing the 350 members and guests present, briefly outlined the work for the season with three goals in perspective—the winning of the Doherty medal, increased efficiency and membership of the section, and unstinted support of Mr. Freeman in his office as president of the N. E. L. A. Following his address Mr. Baily introduced Mr. B. W. Stilwell, vice-president of the Westchester Lighting Company, who spoke on co-operation and good fellowship. Dr. Stilwell's remarks were largely centered around the Golden Rule, his particular point being that the most satisfactory way of achieving success is by elevating one's associates rather than by holding them down.

The second speaker of the evening was Mr. Justice F. E. Crane, of the New York Supreme Court bench, who pointed out particularly that the man who pays strict attention to his present duties is assured of a successful future, whereas the man who in his desire for future welfare is unmindful of the present never attains success. The keynote of the judge's speech was: "I do not know what the future is going to be; I only know this: Here I am, and this is my task. Be the present what it may, let people think what they will, the work I have to do will be done honestly." Mr. W. W. Freeman, president of the N. E. L. A., was the final speaker and based his talk on organization. He showed how the company sections cover a field as important and as beneficial to its members as that of larger and national organizations. He said that the Brooklyn company section served as an example for other larger companies. Mr. R. D. Rubright, chairman of the committee on meetings and papers, made some announcements regarding future speakers and meetings, stating that ex-Secretary

of the Treasury G. B. Cortelyou and Mr. A. E. Steers, president of the Borough of Brooklyn, would address the section at an early meeting. The rest of the evening was given over to social functions followed by refreshments. A business meeting of the section is scheduled for Nov. 7.

Rehabilitation of Chicago Consolidated Traction Properties.

Ending a long contest in the courts and out of them, the ordinance providing for the rehabilitation of the physical property and operating methods of the Chicago Consolidated Traction Company was passed by the Chicago City Council on Oct. 10. The Chicago Railways Company is empowered to purchase the Consolidated Company, and, with this addition, it will be in possession of all the North Side and West Side surface street railway lines in Chicago. Rehabilitation will be begun immediately under an ordinance similar to those governing the Chicago Railways Company and the Chicago City Railway Company, expiring at the same time as the other ordinances. The work will be done under the direction of the Board of Supervising Engineers, Chicago Traction. Track must be rebuilt, new cars must be purchased, substations constructed and arrangements made for securing additional electrical energy to operate the cars. Increased car-house facilities are to be provided also. About 118 miles of street are covered by the ordinance. It is said that the lines which will receive first attention are those on West Madison Street between Fortieth and Sixtieth Avenues, Milwaukee Avenue from Logan Square to the city limits, and Belmont Avenue between Sheffield Avenue and the North Branch of the Chicago River. The Elston Avenue line, which is badly in need of improvement, will also be among the first to be rehabilitated.

The Pacific Coast Electrical Exposition a Success.

The committee in charge of the Pacific Coast Electrical Exposition announces that it will be able to pay back to exhibitors between 50 per cent and 60 per cent on their original subscriptions. It is found that the total expenses of the exposition were approximately $10,200. The total attendance for the eight days, Sept. 17 to 24, was about 40,000, including complimentary admissions. Practically all the exhibitors are unanimous in saying that the exposition was a success and that they derived considerable business from it. This being the first show of its kind on the Pacific Coast many of the electrical firms were skeptical as to its value from a business-return point of view, but they are now convinced that it was well worth the expense and many of them are ready to get up a similar exposition next year. The prevailing sentiment, however, seems to be to have an exposition every two years. As has already been mentioned in these columns, the success of the show was largely due to the untiring efforts of the executive committee, of which Mr. W. W. Briggs, of the Westinghouse Electric & Manufacturing Company, was chairman.

Industrial Exposition at Buffalo.

The third annual exposition of Buffalo manufacturers is being held at Buffalo, Oct. 3 to 15, under the auspices of the Chamber of Commerce and Manufacturers' Club and is the largest and most successful of the local expositions held thus far, in point both of attendance and exhibits. The former armory of the Sixty-fifth New York State Regiment, on Broadway, has been fitted up as an exposition hall and in it are installed 140 exhibits of the varied products of local manufacturers, sixty of them being working, or demonstrating, exhibits under power.

One of the chief attractions of the exposition is the electrical display, which surpasses anything of the kind undertaken in Buffalo since the Pan-American Exposition in 1901, both as regards the illumination in the exposition building, which was exceedingly brilliant, and the street illumination on Broadway between the exposition and Lafayette Square, on Main Street, a distance of seven blocks. The most effective and spectacular feature of the electrical display was the aerial flight of a huge red ball of electric lights from the top of a tall Japanese pagoda in Lafayette Square, which was festooned with electric lights in Japanese lantern designs. The ball passed from the tower down the center of Broadway to the top of an imposing electric arch in front of the exposition building, ricocheting in its course through a series of rings of fire. The flights —or apparent flights—of the ball, which were made in quick succession during each evening, were produced by the successive lighting and shutting off of current in a large number of duplicate red balls of electric lights located at equal distances between Lafayette Square and the exposition.

Many novel and interesting exhibits were made. In electrical lines the largest and most complete was that of the Buffalo General Electric Company, which gave an illustrative exhibit of the generating of electric power at Niagara Falls by means of working models of the great electric generating plants there, showing power houses, canals, tunnels, penstocks, turbines and generators to the minutest detail, together with the transformers, switchboards, distributing apparatus, cables, etc., carrying the current to distant cities. Other exhibits of the same company comprised a "House Electric" of five rooms fitted with all the latest electric devices for domestic uses and performance of various household functions, and a modern printing shop equipped with electrically operated linotype machines, presses and stereotyping room.

New York Edison Company Entertains Contractors.

On the evening of Oct. 14 the New York Edison Company gave its annual smoker to the electrical contractors of New York in the Concert Hall of Madison Square Garden. An excellent vaudeville entertainment was given by professional performers, who appeared as soon as they were released from engagements in the various theaters of the city, and prior to the performance each guest received a bag containing a program, a number of cigars and cigarettes and a package of matches. The music hall was filled to overcrowding with electrical contractors and guests of the company, including the city officials of the Boroughs of Manhattan and the Bronx. The performance fulfilled the traditions of the New York Edison Company for giving the best that the market affords, and at its conclusion a buffet lunch was served in the restaurant of Madison Square Garden. It being then almost midnight, the electrical show was closed to visitors and the electrical contractors and other guests of the New York Edison Company were permitted to inspect the exhibits at leisure. The Edison smokers are always very enjoyable functions and every electrical contractor in New York usually makes it a point to attend them.

The Electric Railway Convention.

The American Electric Railway Association, the new name adopted by the American Street and Interurban Railway Association, finished last week the convention at Atlantic City, N. J., which was the most successful in the history of the industry. Similar changes of name were made by the allied and affiliated associations in the belief that the new title is more appropriate under present conditions than the old.

More than fifty papers and committee reports were presented before the various associations during the week, embracing the wide range of subjects necessary to interest every department of an electric railway organization. Several of these, read before the Engineering Association, were of particular interest from an electrical standpoint.

A report of the committee on power distribution was made by Messrs. A. F. Hovey, vice-chairman; L. L. Foster, E. J. Dunne, E. J. Burdick and William Roberts. Owing to unavoidable delay in the commencement of the work and to the death of the chairman, Mr. James Helwood, no formal report was prepared. However, the specifications for high-tension, three-conductor cable and for low-tension, single-conductor cable, which were included last year in the appendix to the re-

port, were revised and were presented to the convention for discussion. This report was discussed by Messrs. George H. Hill, G. W. Palmer, E. N. Lake, E. J. Dunne and J. W. Corning. Mr. Lake said that the practice in Chicago had been to specify, for cables that were not subjected to any particular mechanical strain, a conductivity of 99 per cent. Mr. Hill read a criticism of the specifications which had been written by Mr. Wallace Clark, General Electric Company. Mr. Clark suggested that the requirement of 98.5 per cent conductivity was rather high. As an appendix the committee submitted specifications for overhead crossings of electric transmission lines, prepared as a proposed joint report of the committee on electricity of the American Railway Engineering and Maintenance of Way Association and the committee on overhead line construction of the National Electric Light Association.

The Engineering Association received also a report of the committee on equipment, composed of Messrs. John Lindall, chairman; H. A. Benedict, M. V. Ayres, R. C. Taylor, Terrance Scullin and A. T. Clark. This report included a "Consideration of Methods of Reducing Weights of Cars on New Construction, with Due Allowance for Strength of Parts." In connection with the consideration of this subject the reduction in weight of electrical equipment was taken up with the electrical manufacturers, and it appeared that the motor frames have been lightened from time to time until they are made as light as possible, consistent with mechanical strength and magnetic sections, renewable shaft, wearing depth of commutator bars, etc. Some saving of weight can be made by substituting sheet steel for malleable iron in gear cases, motor covers, etc., but in many instances this change has not been acceptable to the purchaser.

The manufacturers also suggested four possible means of reducing weight of electrical equipment, as follows:

"First—By increasing armature speeds—recent improvement in pinions, carbon brushes, commutator surfaces and brush holders tending to make this possible.

"Second—By forced ventilation of motors.

"Third—By the use of fireproof insulation and operating motors at higher temperatures.

"Fourth—By the use of field control, which would permit reduction of rheostat weights."

The committee stated that it believes these suggestions are worthy of very careful consideration.

A report was also presented by the committee on heavy electric traction, consisting of Messrs. J. S. Doyle, chairman; E. R. Hill, E. B. Katte, W. S. Murray and J. H. Davis. It included a report on the standard location of third-rail working conductors. The committee confined its considerations mainly to the standard adopted by the American Railway Association. It assumed that the third rail will be used only in connection with strictly heavy electric traction operations and, therefore, confined its attention chiefly to conditions that obtain on American steam railroads, such as have already adopted or might be expected to adopt heavy electric traction on one or more of their lines. On this basis of procedure it was found that the data and conditions governing the adoption of a standard location at this time are practically the same as those upon which the American Railway Association based its action in 1908, and the committee considered that the conclusions reached by that association are consistent with the data and, therefore, recommended the same standards. The committee also recommended terms and definitions for adoption in connection with third-rail working conductors. Mr. Katte wrote that a meeting of a committee of the American Railway Engineering and Maintenance of Way Association would be held at which a third-rail clearance diagram somewhat different from the one in the committee report would be considered, and he therefore suggested that consideration of that portion of the committee report be deferred. The recommendations for standard location of third-rail working conductors were, therefore, referred back to the committee for further consideration during the coming year.

The committee on standards recommended that the section of No. 4-0 grooved trolley wire recommended by the 1909 committee on power distribution be adopted as a standard. It recommended that the committee on power distribution consider the design of standard sections for other sizes of grooved trolley wire, all to have, if possible, the same contour of groove in order that one hanger may be used for all sizes. The committee voted for approval of the copper-wire table recommended by the committee on power distribution. The committee also recommended that cables be specified in orders by circular millage instead of by gage number. The committee asked that the committee on power distribution be requested to prepare a standing table and to define the difference between a "strand" and a "cable." The association adopted, in accordance with the recommendations of the committee, the section of grooved trolley wire and the wire table. The committee on standards consisted of Messrs. Paul Winsor, chairman; H. H. Adams, E. O. Ackerman, W. S. Murray, John Lindall, J. H. Hanna, G. W. Palmer, Jr., and Martin Schreiber.

A report of the committee on power generation was submitted by Messrs. H. G. Stott, vice-chairman; G. H. Kelsay, C. E. Roehl, J. D. Andrew and E. D. Smith. The subjects considered in the report were as follows: "Forced Draft"; "Flue Gas Analysis"; "Low-Pressure Steam Turbines"; "Steam Meters," and "Peak Loads."

The exhibits were easily accessible in the booths on Young's Million Dollar Pier and made an attractive appearance. Over 180 manufacturers made exhibits and the decorations made a fine setting for the many varieties of apparatus displayed.

Mr. Arthur W. Brady, Anderson, Ind., was elected president of the American association for the ensuing year. The newly elected presidents of the other associations are as follows: Engineering, Mr. W. J. Harvie, Syracuse, N. Y.; Accountants', Mr. William H. Forse, Jr., Anderson, Ind.; Claim Agents', Mr. H. V. Drown, Newark, N. J.; Transportation and Traffic, Mr. H. C. Page, Worcester, Mass.

Annual Meeting of Sons of Jove.

The eighth annual meeting of the Order of Rejuvenated Sons of Jove was held at Birmingham, Ala., on Oct. 13, 14 and 15, with headquarters at the Hotel Hillman. The convention was one of the most enthusiastic and successful in the history of the order. The local arrangements for the regular sessions, entertainment and "rejuvenation" were excellent. Out-of-town delegations arrived early and remained until the final adjournment on Saturday night. The entire business section of the city was elaborately decorated by day and brilliantly illuminated by night. Flags, bunting, cards of welcome and electric signs, especially designed, were in evidence everywhere.

Business sessions were held in the City Council chambers. The Mayor of the city, Hon. Culpeper Exum, extended the freedom of the city at the opening session on Thursday, and after being duly initiated into the mysteries of the Order proved himself a loyal Jovian.

The entertainment features included a theater party, visit to the Alabama State Fair, banquet, automobile trips about the city, and a trip to the great steel plants, the coal mines and the iron industries that, in the past ten years, have given Birmingham the largest proportionate increase of population in the whole United States—38,000 in 1900 and 133,000 in 1910, nearly 250 per cent.

The retiring head of the Order, Jupiter Oscar C. Turner, of Birmingham, reported an increase of over 1000 members during the year, making a total membership of nearly 4000. Greater plans for increasing the usefulness of the order as the one great co-operative force in the world of electricity to-day were inaugurated; the spirit of "All Together, All the Time, for Everything Electrical"—the slogan of Jovianism—received a new impetus; the idea of fraternity and good fellowship as the fertile seed of sound commercial growth in prosperity was born anew; the creation of a greater market, common to all, by the elimination of trade jealousies, unfair methods of commercial competition, suspicion and misunderstanding, was the keynote of the convention spirit.

A "rejuvenation," or initiation, was held on the last night, at

which time thirty new members were received. The order now numbers among its four thousand members many of the most influential and most prominent men engaged in the electrical industries throughout the United States, Canada and Mexico.

The officers elected for the next year are as follows: Jupiter, Mr. John F. Dostal, Denver Gas & Electric Company, Denver, Col.; Neptune, Mr. H. B. Crouse, Crouse-Hinds Company, Syracuse, N. Y.; Pluto, Mr. J. P. Lawrence, Nashville, Tenn.; Vulcan, Mr. C. C. Hillis, Electric Appliance Company, San Francisco, Cal.; Mercury, Mr. R. M. Van Vleet, Cutler-Hammer Manufacturing Company, Chicago, Ill.; Mars, Mr. A. C. Beattie, Cincinnati, Ohio; Hercules, Mr. M. F. Sterritt, Hobson Electric Company, Dallas, Tex.; Apollo, Mr. W. N. Matthews, W. N. Matthews & Brother, St. Louis, Mo.; Avrenim, Mr. R. C. Kemp, Montana Electric Company, Butte, Mont.

One hundred telegrams from the Governor of Colorado, the Mayor and President of the City Council of Denver, Frank W. Freuauff, ex-president of the National Electric Light Association, and all the leading electrical men of Denver secured for the "City in the Clouds" the next annual meeting, and the high office of Jupiter, whose throne is on Mount Olympus, the goal and Mecca of every true and loyal Son of Jove.

Boiler Manufacturers in Convention.

The American Boiler Manufacturers' Association held its twenty-second annual convention in the Auditorium Hotel, Chicago, Oct. 10 to 13. This association is composed of about seventy-five manufacturers of steam boilers in the United States and Canada, who operate "contract shops," that is, manufacture boilers on a commercial scale for sale to the trade rather than make boilers for their own use, as is the case with some steam-railroad companies and other concerns. Allied with the parent association is a supply men's association, which provides the entertainment at the annual conventions.

Various questions of interest to boiler makers were discussed at the open and executive sessions of the association. Mr. George A. Uhler, chairman of the Board of Supervising Inspectors of Steam Vessels for the United States government, was present as an invited guest and addressed the association. He said that the boiler plate produced to-day is better than ever before and that this is true both in respect to marine boilers and those used in power plants on land. In relation to the question of spring safety valves versus lever safety valves, Mr. Uhler expressed his personal preference for spring safety valves, but, nevertheless, the majority of the board of which he is chairman permits the use of lever valves under certain conditions, and, therefore, this is the ruling that obtains, as the decisions of the board are made by a majority vote.

Some time was devoted to the discussion of boiler explosions, particularly whether they are to be ascribed to defects of material and workmanship or to carelessness or neglect in operation. One speaker recounted several instances of failure where it was found on investigation that the boilers did not conform to a true circle at the longitudinal joints. This possibility of flattening at the joints is an important consideration in the construction of steam boilers having butt-strap joints. However, care and management after the boiler is installed have a vital bearing on the question of safety. The rules formulated by the Board of Boiler Rules of Massachusetts were referred to with approval, and the general opinion seemed to be that the carefully worked-out regulations of the Massachusetts board are worthy of adoption elsewhere. Copies of the engineers' and firemen's license law, the boiler inspection law and the boiler rules prevailing in Massachusetts were distributed among the members present.

Mr. W. S. Blake, of the Hartford Steam Boiler Inspection & Insurance Company, was present, and in response to a request for his views said that the responsibility for boiler failures should be divided between manufacturers, owners and operators. He laid stress on the point that the owner of the plant at fault could not evade his fair share of responsibility when the accident may have been caused by his neglect or carelessness. Mr. Blake also pointed out that there is room for improvement in the material used in the manufacture of boiler tubes. There has been great improvement in the manufacture of steel plate for boilers, and now the tubes are apparently the weak link. The manner of welding the tubes is also important, as examination after failures of tubes often shows that the tube has given way at the joint or weld.

President Meier said that the boiler-insurance companies should protect the manufacturers by detecting and endeavoring to correct bad practice in their operation of boilers.

Another speaker dwelt earnestly on the deplorable lack of uniformity in relation to the local laws and regulations governing the manufacture, installation and operation of steam boilers. The government has very rigid requirements in relation to boilers designed for the navy and for marine use generally. A man's life on land is worth as much as on shipboard, and the speaker thought that the government restrictions might well be applied to land plants. However, the difficulty is that Congress has no jurisdiction in this matter, as regulations of this kind are reserved to the several States under our form of government. The consequence is that there are many sets of rules and regulations referring to boiler practice that are most vexatious to boiler manufacturers. For instance, a boiler that may be installed in most Pennsylvania cities will not be accepted in Philadelphia, and a boiler that will pass inspection in Philadelphia will be rejected in Massachusetts. Again, a boiler considered satisfactory in Massachusetts will not be accepted in Philadelphia. Thus the matter of uniform specifications is very important, for not only do boiler regulations vary in different States, but in some cases in different cities of the same State.

Captain Norton, of the United States Navy, referred briefly to boiler practice on warships. One point he brought out was that in the navy a boiler is never blown off to clean it. The water is allowed to cool in the boiler first to prevent undue contraction.

A member from Toronto explained that the same difficulty in relation to uniform boiler regulations is experienced in Canada as in the United States. An effort is now being made to induce the legislatures of the various provinces to enact a uniform law on this subject.

Mr. Brown, a delegate from the International Master Boiler Makers' Association, was introduced and spoke briefly.

Officers were re-elected as follows: President, Mr. E. D. Meier (Heine Safety Boiler Works), New York. Vice-presidents, Mr. T. M. Rees, of Pittsburgh; Mr. J. Don Smith, of Charleston, S. C.; Mr. W. A. Brunner, of Phillipsburg, N. J.; Mr. H. D. MacKinnon, of Bay City, Mich., and Mr. M. A. Ryan, of Duluth, Minn. Secretary, Mr. J. D. Farasey (H. E. Teachout Boiler Works), Cleveland. Treasurer, Mr. Joseph F. Wangler, St. Louis.

Boston was selected as the place of next year's convention.

Discussion on New York Subway Situation.

At an informal public engineering meeting held in the Engineering Societies Building on Oct. 17 the rapid transit requirements of Greater New York were discussed by Messrs. F. J. Sprague, formerly member of the electrification committee of the New York Central Railroad; W. J. Wilgus, formerly vice-president of the New York Central Railroad; L. B. Stillwell, formerly consulting engineer of the Interborough Rapid Transit Company; W. S. Murray, electrical engineer of the New Haven Railroad, and R. W. Dowling, president of the City Investing Company.

The paper of the evening was presented by Mr. Sprague. In this paper was given an outline of the early history of traction commissions in New York, and the success attending the operation of the present subway system. The author discussed in detail the proposed route known as the "Tri-borough," which he criticised as being divided into two entirely separate divisions; that is, instead of there being a track system permitting through train movement over the entire line, there are north and south Manhattan and Bronx routes

constituting one entity, and the Canal Street, bridge loop and Brooklyn extensions another, intersecting at different levels, without track connections, at Canal Street and Broadway only. He claimed that the Tri-borough system is mistakenly conceived and unwisely promoted, and that if its construction as now planned is persisted in the result will be a far-reaching disaster.

On the other hand, the Interborough Rapid Transit Company has proposed Lexington Avenue and Seventh Avenue subways, which constitute a natural H-formation with the existing Manhattan routes, and in addition there is at the lower end a duplicate line to Brooklyn, while at the upper end the two branches of the present system are bifurcated by an elevated extension connecting with the Lexington Avenue subway and with the Eighth Avenue elevated, and a short distance south of this junction connection is made with the West Farms branch of the present subway. In addition, and independently of extra tracking, the Third Avenue elevated is extended to the Yonkers line, and the Second Avenue elevated over the Queensboro Bridge.

Mr. Sprague contended that the extensions thus projected are entirely natural, are well planned, and constitute a logical development. Operated as a single system, if satisfactory terms can be made with the city, there is here promised the maximum of relief and accommodation to the greatest number of people—to the extent of doubling the present capacity—in the shortest time, and at the least possible capital expense. It would afford direct north and south through-travel on the east and west sides of the city through non-competitive territory, free interchange between the two sections, and alternative connections to Brooklyn, as well as transfer to Long Island City by way of the Steinway Tunnel. It would tap the terminus of the New York Central, Harlem and New Haven Railroads, and would equally serve the new station of the Pennsylvania and Long Island Railroads, with its daily movement of a thousand trains, and through the Hudson & Manhattan Railroad Company afford connections with Jersey City and Hoboken, and the Pennsylvania, Erie and Lackawanna stations across the river.

Mr. Wilgus remarked that the construction of a subway along some such route as that proposed by the Interborough would prove of much benefit to the property located on the west side of the city below Forty-second Street, while the building of a subway according to the Tri-borough plan would be of little benefit to the property in any locality.

Mr. Stillwell said that the plans of the Tri-borough system would involve the expenditure of much money uselessly for an opening too large for the present cars and too small for foreign cars. He expressed the opinion that it is altogether proper for engineers to exert their influence in insuring the selection of proper plans for engineering work in which the public is interested.

Mr. Murray claimed that no mistake would be made in building the future subways with greater clearances, because the time will surely arrive when it will prove advantageous to admit foreign cars to the subway system.

Mr. Dowling said that real estate men are vitally interested in transportation problems, and he believed it to be to the best interest of the city as a whole to provide improved transportation facilities in territory as yet undeveloped. A route connecting the upper east side with the lower west side, as proposed by the Interborough, would prove of great benefit to property holders in these localities. The increased taxes accompanying the increase in property values would go far toward paying for the transportation system.

Potential Stresses in Dielectrics.

At a meeting of the American Institute of Electrical Engineers held on Oct. 14 a paper by Messrs. Harold S. Osborne and Harold Pender was presented by Dr. Osborne. This paper dealt with the potential stresses in dielectrics, especially in the insulation used in cables.

Particular attention was paid to the equalization of the stresses within the dielectric in order that all parts may benefit by equal factors of safety. The layers of dielectric may be subjected to equal stresses either by separating the layers by metal foils subjected to proper potential differences or by increasing successively the capacity of the inner layers. The first method, requiring sources of various potentials, is not adapted to many cases, but can conveniently be applied in the insulation of a transformer, where any desired voltage may be tapped from the high-tension winding.

The most obvious way of applying the method of increasing the capacity of the inner layers is to separate the layers by metal foil and connect additional condensers across the inner layers. This method has been suggested for underground cables, but it has the disadvantage that it requires apparatus external to the cables themselves. This method has, however, been applied very ingeniously and successfully to the design of the condenser type of transformer terminal.

A method of increasing the capacity of the inner layers which is capable of a broader application, and which does not require the insertion of metallic layers, is the "grading" of the specific capacity of the dielectric, making it higher in the inner layers than in the outer. This method has the advantage that it does not require the insertion of metallic layers between the layers of insulation. It is this method which is being applied in the manufacture of extra-high-tension cables.

The authors outlined the mathematical theory of grading and showed the advantages to be obtained from using two, three, four or more layers of different material for the dielectric. They developed formulas for showing the best theoretical design of a graded single-conductor cable of certain given types for any given conditions. The effect of the conductivity of the dielectric was found to be entirely negligible for ordinary materials and ordinary frequencies of alternating-current working. Results of experiment indicate that a solid dielectric, when overstressed, becomes pricked with a number of needlepoints of disrupted material. By this hypothesis these results, and those of earlier experiments, are explained without violating the assumption with regard to the electric strength of a dielectric which is the basis of all analytical work on the subject. The authors expressed the opinion that their analytical results are based on proper assumptions, but when they deal with cases of partial breakdown they must be modified to take account of the true character of that breakdown.

DISCUSSION.

In a written communication Prof. J. B. Whitehead, of Johns Hopkins University, explained the phenomena described by the authors on the basis of the ionization theory. He stated that since the distances between the ions which enter into the phenomenon of disruption in solid dielectrics are very much smaller than those involved in gases, by steadily decreasing the size of wire any tendency of the electric strength to present an apparent increase must occur at very much smaller diameters than those obtaining in the case of a gas.

Mr. Milton Franklin, Schenectady, N. Y., remarked that the dielectric stress corresponds to a mechanical stress similar to a hydrostatic pressure and is accompanied by a proportionate strain, the values being expressible in pounds per square inch. The failure of the dielectric is due to the periodic application of this stress and the ultimate fatigue of the material.

Dr. A. E. Kennelly called attention to the impossibility of practically rendering the layers in a graded cable homogeneous by reason of the inevitable presence of imperfect joints in the electrostatic circuit. Local concentration of electrostatic flux may cause a partial breakdown which by spreading will result in total rupture.

Prof. W. S. Franklin, of Lehigh University, explained the progressive rupturing of a dielectric by means of an analogy with the movement of a crack across a pane of glass when subjected to a very slight stress.

Mr. W. I. Middleton, of Boston, compared the results obtained with old formulas with those due to the newer formulas and showed that whereas in a certain cable designed according

to the old formula a 4 5/32-in. wall was used, at present a 9/32-in. wall is found to be satisfactory.

Mr. H. W. Fisher, of Pittsburgh, expressed the belief that breakdowns of overstressed cables must be caused, in the first place, by a gradual puncturing of the insulation around the conductor at the weakest point. An absolutely continuous disintegration of overstressed portions is impossible, and until an actual breakdown occurs between the conductor and the sheath the action of isolated discharges must take place more or less all along the conductor.

Mr. Henry Morse, of Boston, stated that in the actual manufacture of cables final dependence must be placed upon test data rather than upon theory, especially when dealing with the smaller sizes of wire.

Mr. Percy H. Thomas, of New York, called attention to the effect of temperature upon the breakdown of dielectrics. To this effect he attributed the fact that, say, fifty thin sheets can withstand perhaps only as much e.m.f. as five times that withstood by one sheet. There will be some spot where the loss will be locally a little larger than elsewhere, and here the temperature will rise, thereby increasing the local loss, the character of the material being such that the loss in energy is not dissipated as rapidly as formed, and hence a breakdown occurs.

Mr. C. J. Fechheimer called attention to the fact that graded insulation is used to advantage on the coils of high-voltage alternators. Use is made of an inner covering of flexible mica and a binder of varnished cloth or linen tape.

Mr. A. H. Pikler remarked that it is not practicable to use graded insulation in high-voltage transformers. The ability to construct high-voltage transformers depends mostly upon the possibility of removing moisture from the insulation and maintaining the equipment free from moisture.

Dr. C. P. Steinmetz said that high-voltage cables are probably never broken down by their operating voltage, but they break down at a weak spot, such as an air bubble, a lack of homogeneity in the insulating material or by reason of a transient over-voltage due to an electric impulse of limited energy but more or less unlimited voltage. It is of prime importance to eliminate all weak spots from the insulating material, and to employ material requiring an appreciable amount of energy as distinguished from power to cause disruption. The deterioration of insulation when stressed beyond its dielectric strength by the formation of pinholes is a fairly well known fact. In the early days of the application of high-voltage cables it was suspected from the life history of the cables that a deterioration of the insulation takes place by the formation of pinholes, and evidence of these phenomena was afforded by the investigation and study of the insulation in very high voltage transmission systems. In those cases where the insulation had been strained beyond its dielectric strength under conditions where no secondary phenomena, such as short-circuiting arcs, had destroyed the evidence, it was common to find the surface perforated by innumerable pinholes which, in the case of a very high voltage transmission line where the electrostatic energy is very large, reach visible size. Thus if the over-strained insulation is perforated by pinholes, either microscopic or visible, then the electrostatic field is brought to bear on the outer insulation in a concentrated form and the outer insulation is exposed to what may be called an electrostatic shearing strain. This fact explains the breakdown of a glass tube in tests at a voltage far below that which it would stand when exposed to a uniform static field.

Mr. C. O. Mailloux outlined experiments showing that when a dielectric is subjected to an excess voltage that will in time cause rupture it will always return almost to its initial condition if the e.m.f. is applied for a time less than that necessary for a breakdown and then removed. The phenomenon seems to be one of temperature effect.

Street Lighting Discussion by I. E. S.

At the meeting of the New York Section of the Illuminating Engineering Society held on Oct. 13 the general subject for discussion was street lighting, upon which subject three papers were presented. A paper by Mr. P. S. Millar dealt with the bearing of silhouetting on illumination, which was illustrated by means of a model of three blocks of city streets, while a paper by Mr. A. J. Marshall described a new street-lighting installation in Washington. Abstracts of these papers are given elsewhere in this issue.

Mr. H. S. Whiting discussed the phenomenon of glare in illumination and described a street-lighting unit which allows the glare to be reduced to a satisfactory value. The unit consists of a tungsten lamp equipped with a prismatic reflector for delivering the major portion of the light between 25 deg. and 60 deg. below the horizontal plane, and provided with an opal envelope for reducing to practically zero all light above the 25-deg. angle. He called attention to the work of investigation done by Mr. A. J. Sweet, who found that when the light is concentrated below 26 deg. all glare is avoided.

The discussion on the paper was opened by Dr. C. H. Sharp, who attributed largely to the introduction of the high-efficiency incandescent lamps the marked improvements that have been made in the illumination of streets during the past few years. Marked changes have taken place not only in the effectiveness of the illumination, but also in the appearance of the lighting equipments. By eliminating glare the effectiveness can be greatly increased. In the lighting unit described by Mr. Whiting the glare has been minimized and the appearance is highly satisfactory.

Mr. W. H. Gardiner remarked that there are three general classes of street lighting. The first of these is the mere marking of the way so that one may find the road readily. The second is the class mentioned by Mr. Millar, namely, silhouetting. The third is the true illumination of the streets in order that objects thereon may be seen directly rather than by contrast. The last named is sometimes overdone, as in St. Louis, where the street illumination is so excessive that the signs of the merchants are rendered inconspicuous and hence ineffective.

Mr. A. J. Marshall expressed the opinion that the light of street lamps in the upper hemisphere should be suppressed in both the residence district and the business district. In the former district the residents object to the light thrown against the houses, while in the latter district the merchants wish their signs to remain conspicuous.

Mr. V. R. Lansingh said that in street lighting a variation in illumination of less than four-to-one along the street should be considered highly satisfactory. With the type of equipment described by Mr. Whiting such a result can readily be obtained. The opal envelope used with the equipment serves to protect the prisms of the reflector from moist dirt, which would absorb much of the light. It can be used as a street marker, by reason of the light which escapes through its opalescent sides. In reply to a question by Mr. Gardiner Mr. Lansingh stated that while the electric power consumption for store-window lighting may reach 100 watts per front-foot, that for street lighting seldom exceeds 10 watts.

Factory Lighting.

Mr. F. J. Pearson, the recently elected chairman of the Chicago section of the Illuminating Engineering Society, presided at the first meeting of the section for the season held after luncheon at the Great Northern Hotel in Chicago on Oct. 13. Mr. Pearson announced that nearly all the subjects to be discussed at the monthly meetings during the entire season had already been determined by the board of managers. The calendar is as follows:

November—Résumé of the Johns Hopkins University course of lectures in Baltimore on illuminating engineering, by members of the Chicago section who attend.. December—Results of original research at the laboratory of the University of Illinois. Papers to be presented by Prof. J. M. Bryant and Mr. Hick. January—Discussion of Dr. E. P. Hyde's lectures on *Luminous Efficiency,* led by Mr. A. L. Eustice. February—*Illuminating Problems in the Smaller Cities,* by a central-sta-

tion manager to be announced. March—*Illuminating Features of the New Building of the People's Gas Light & Coke Company in Chicago*, by Mr. Charles A. Luther. April—*Train and Car Lighting*, by Mr. C. R. Gilman, of the Chicago, Milwaukee & St. Paul Railway Company. May—*The Lighting of Small Rooms*, by Mr. J. R. Cravath. June—*Natural Daylight Illumination*, by an author or authors not yet announced.

The election of a secretary for the Chicago section resulted in the unanimous choice of Mr. F. H. Bernhard.

Chairman Pearson remarked that during the last three months the society had secured 500 new members and that 200 of these belong to the Chicago section. He then introduced as the speaker of the day Mr. Joseph Newman, Jr., of the International Harvester Company, who read a paper on the subject "Good Lighting from a Factory Viewpoint," which was followed by a discussion.

Mr. Newman pointed out that the keynote of the modern factory system is efficiency, and efficiency is greatly aided by keeping production at its maximum during the entire length of the working day. Few factory managers in the past have been willing to believe that money spent to make the transition from daylight to artificial light as little apparent as possible will pay dividends. Lack of light has undoubtedly caused a large amount of waste of human energy and of material. Well-lighted, well-ventilated shops make for peace of mind, and are important factors in the foundation of an efficient organization.

Further, good lighting is an economy in the bearing it has on the accident account. Millions of dollars are paid every year because of unguarded machinery and badly lighted shops. It is perfectly feasible to eliminate accidents due to lack of light.

In factory lighting all the attending conditions must be considered. Among these are the possibility of keeping shop walls and ceilings clean and of a light tint, the color of the manufactured product, the size of the parts made and the operations performed upon them. The shape of the machines used and the degree of accuracy necessary in the operation of these machines have also to be taken into account in planning the amount and distribution of light. Also the number of parts handled per unit of time and the closeness with which it is necessary to inspect them must be considered. Where the factory is on a piece-work basis, it is to be remembered that poor light means that careless work may pass undetected.

In the foundries where large castings are made the lighting must be fairly even, avoiding dense shadows, but the intensity need not be great. Units of high candle-power hung high enough to avoid the cranes and powerful enough to overcome the great absorptive power of the black molding sand must be used. For small castings there must be in addition a small lighting unit at the bench or stall of each molder. Malleable-iron foundries require a greater amount of general illumination than those in which gray iron is made. This is due to the greater quantity of steam and smoke. In foundry work where no help can be obtained from reflecting surfaces, it is necessary to expend enough energy to furnish from ½ cp to 1 cp per square foot of floor area, depending upon the height at which it is necessary to hang the lamps and the amount of smoke and vapor present. This will be sufficient for general illumination, but for the finer work a few portable lamps may be necessary. For heights of less than 20 ft. units of 300 cp or 400 cp, with good reflectors, give the best results.

In machine shops a smaller expenditure of energy than in foundries will give good results. Here the work must be well lighted, but the general surroundings do not require a high degree of illumination. An expenditure of energy resulting in the lighting of 4 sq. ft. per candle-power, with good reflectors, should be sufficient if well distributed. This means from ½ foot-candle to 1½ foot-candles on a plane 30 in. from the floor, the lamps being hung 10½ ft. high. Tungsten 100-watt lamps form a convenient unit. Large enameled intensive reflectors are the most useful. Lamps may be placed at irregular intervals, concentrating on the work and tools, except in the main gangways. Lathes, punching and forming presses will probably require individual lamps, and these may be 8 cp in size. Of course, much will depend on the character of the work done in the shop.

Woodworking shops are easily lighted by the judicious placing of the intensive units over the machines. Almost all of the work can be lighted from the top, the ability to see the grain of the wood being one of the most important points. From its color, woodwork is easy to light, and the results from the same expenditure of energy as in the machine shops are gratifying.

In paint shops where the results wanted are broad and considerable dipping is done the illumination needed is no greater than in machine shops. Striping and work of that nature require a greater intensity of light. This is obtained by lowering the lamp and using a closer spacing of units.

Warehouses used only for storage require but a low intensity of light, except along the main gangways, where there is much traffic. Lamps of 16 cp spaced 16 ft. apart under flat shades will answer very well. These lamps should be placed as close to the ceiling as possible, so that the stock may be piled high.

In factory lighting generally the one feature to which all others must be subordinated is reliability. Simplicity comes next, and the cost of maintenance is third. The first cost is often a determining factor when the necessity for a change in the lighting system has made itself apparent. In improving old lighting systems the value of the tungsten lamp is apparent, for a few lamps can be purchased at a time, and, with suitable shades, attached to the old system of wiring.

Mr. Newman told of a case where in a foundry having an open-arc installation it was necessary to keep a man on night duty the year around to prevent outages and open-circuits. A large number of incandescent lamps are used as auxiliary to the arcs, but the lighting was uneven and unsatisfactory. Gradually tungsten lamps were introduced, equipped with simple shades. The foundry men found that they always had light when they needed it, without the aid of a trimmer, and that the distribution was far more efficient. In about eighteen months the night trimmer was dispensed with, and the system required only about three hours' attention a week for cleaning. Gradually 100-watt tungsten lamps were introduced throughout the whole factory. They are provided with 16-in. porcelain-enameled bowl shades, and are spaced 18 ft. apart, suspended at a height of 10½ ft.

The speaker contended that the reflector is the factor upon which the success or failure of factory lighting depends. Porcelain enamel finish is the only one which has proved itself sufficiently durable, and the intensive distribution of light is the form which finds the largest use. Reflectors are most efficient with the larger sizes of lamps.

In concluding Mr. Newman declared that the factory wants a lighting system at a minimum first cost, even at the sacrifice of some efficiency. It wants a system which will give twenty-four-hour service, with a minimum of unskilled attention. It wants a unit which will fit naturally into the divisions of shop space made by the post-supported mill construction. It wants a large percentage of the light concentrated on the machines and work, but enough general illumination in all parts of the shop to make movements as safe as under daylight conditions.

DISCUSSION.

Mr. Price, of the International Harvester Company, spoke of the beneficial effect of good lighting on the workmen. The men are better satisfied with their work where the lighting is good. The old-style dark factory is passing, for it is found that good lighting has a distinct economic value.

Mr. J. R. Walter, of the Curtis Publishing Company, of Philadelphia, which is erecting a large printing and publishing plant, where modern methods of illuminating engineering will be employed, spoke briefly. He referred to the losses in workplaces from thoughtless, careless and inefficient lighting. He pointed out that women, in particular, are often affected by nervous troubles due to eye strain, and where large numbers of women are employed particular attention should be paid to the lighting facilities.

Mr. Frost, of the Atchison, Topeka & Santa Fé Railroad, stationed at Topeka, Kan., said that he was convinced that good illumination in shops increased the efficiency of the men, reduced the danger from accidents and resulted in increasing the output. Particular attention should be given to general illumination, making the general appearance of the factory bright and cheerful. Money spent in this way produces dividends.

Mr. A. T. Hunt, of the Arnold Company, consulting engineers, agreed with the preceding speakers that good illumination paid in increasing the efficiency of the men. He added that the effect on the men depends largely upon the general and complete illumination of the entire floor.

Answering a question put by Mr. Albert Scheible and relating to the reduction in accidents due to improvement in lighting, Mr. Price told of one large company which found that 43 per cent of its operatives were disabled by accident for one day or more during the year. By the use of modern methods of sanitation, ventilation, welfare work and lighting this percentage was reduced to 19. This greatly improved result was due largely to better illumination.

Another gentleman pointed out the necessity of maintaining the lighting system after it had been installed. Cleanliness is needed to make the lighting effective. Lamps, globes and reflectors should be frequently cleaned, and in this way perhaps 33 per cent may be added to the efficiency of the system. Mr. Newman remarked that two men were kept busy all the time in the factory of the International Harvester Company, in Chicago, in cleaning lamps, globes and reflectors. Sometimes it is necessary to employ a third man. In the foundry the lamps are cleaned once a week.

Mr. A. D. Curtis inquired if in factory lighting it was not considered desirable to conceal the source of light from the direct line of vision. Mr. Newman answered that the reflector used in his company's factory is 7 in. deep and hence the 100-watt tungsten lamp is concealed unless one is almost underneath the lamp and looks up at it.

Omaha Meeting of the Western Association of Electrical Inspectors.

The sixth annual convention of the Western Association of Electrical Inspectors was held in Omaha, Neb., on Oct. 11, 12 and 13. The opening session began promptly, and Mayor Dahlman, of Omaha, very wittily and heartily presented the association with the freedom of the city, President Dustin responding for the association.

In an address by Mr. Dustin, city electrician of Minneapolis, was emphasized the "local authority" difficulty existing among Central and Western electrical inspectors generally before the association had been formed. The immense gain by increasing uniformity of interpretation and of construction requirements was noted. It was recommended that members endorse and promote state legislation to control electrical construction and inspection where municipal control of good grade cannot be secured.

A report from the executive committee by Mr. J. H. Montgomery, of Detroit, especially brought out the difficulties of committees in securing whole-hearted co-operation even from committee members, to say nothing of other members of the association. The committee reports must be the substance and form the particular value of conventions and the personal note of them is too often unavoidably evident.

The secretary's report by Mr. W. S. Boyd, of Chicago, among other matters, particularly recommended a campaign to secure municipal members from small cities. The objections to October as a meeting time have become so pronounced that an effort will be made to change to the first of the year. A bulletin plan which has been in effect during the past year has been producing excellent results.

A considerable portion of the meeting was spent in the presentation and discussion of reports of committees, to which the sessions of Oct. 11 and Oct. 13 were largely devoted. On Oct. 12 papers were presented as follows: *Rubber-Covered Wire,* by Mr. Lewis G. Martin, engineer of the Okonite Company; *The Influence of Electrical Inspection on the Operation of the Telephone System,* by Mr. A. S. Rogers, plant engineer of the Nebraska Telephone Company; *Packing House Wiring,* by Mr. T. J. Brynes, chief electrician of the Cudahy Packing Company; *The Legal and Ethical Responsibility of the Electrical Inspector,* by Mr. John A. Rhine, assistant city attorney, Omaha, Neb., and *The History and Development of the Incandescent Lamp Industry,* by Mr. R. E. Campbell, of the National Electric Lamp Association. Among the reports of committees were the following, which were prepared by the chairmen indicated: *Uniformity in Rulings,* by Mr. William S. Boyd, Chicago; *National Electrical Code,* by Mr. J. H. Montgomery, Detroit; *Outside Wiring,* by Mr. Waldemar Michaelson, Omaha; *Theater Wiring and Show Equipment,* by Mr. V. H. Tousley, Chicago; *Construction and Installation of Electric Signs,* by Mr. Emil Anderson, Minneapolis; *Show-Window and Display Lighting,* by Mr. Fergus P. McGough, Omaha; *Instructions to the Public Concerning the Safe Operation and Maintenance of Electrical Wiring and Apparatus,* by Mr. Thomas D. McColl, Toledo; *Underground Systems,* by Mr. Hugh T. Wreaks, New York; *Installation and Operation of Induction Motors,* by Mr. Charles W. Arrick, Minneapolis; *Electrical Hoisting Apparatus,* by Mr. W. J. Gilsdorf, Lexington, Ky.; *Laws and Ordinances,* by Mr. William S. Boyd, Chicago; *Architects' Specifications,* by Mr. F. H. Moore, Indianapolis; *Signal Systems,* by Mr. Frank S. Anderson, Evanston, Ill.; *Public Safety,* by Mr. W. J. Canada, Denver; *Electric Traction Systems,* by Mr. F. R. Daniel, Indianapolis.

Among the entertainment features was an informal dinner given to the members by the Omaha Electrical Club on the evening of Oct. 11. The table was wired in an "approved" exposed conduit construction with condulets, 2-in. conduit being used, and portable lamps tapped at intervals. Signal wires, bells, etc., made applause most effective. Some "defective cord" which was much in evidence was dramatically "cut out" with a pair of pliers by Mr. McGough, assistant city electrician.

REPORTS.

Secretary Boyd read the report of the committee on uniformity in rulings. The tendency of conventions and the discussions that arise has been not only to secure uniformity, but to improve the standards in certain respects in every locality, while acting as a flywheel to the ambitious efforts of some members for wholesale, and perhaps ill-considered, advances in construction methods.

Mr. Michaelsen read the report of the committee on outside wiring. The desirability and obstacles in the way of joint-pole construction were summarized. The problem of safeguarding the public was shown to lie largely in the 2300-volt lines, since higher voltages have infrequent crossings with building services and the still higher voltages are usually on private rights of way. The apparent impossibility of any positive protection to linemen was discussed, and it was recommended simply to advise eternal vigilance and to emphasize at all times the essentially hazardous character of such work. State and ultimately interstate regulation of pole-line construction methods, especially safeguards against communication of higher voltages to lines of normally lower voltage, was recommended.

Many of the recommendations brought out by the "code" committee were not approved because of ambiguity or uncontemplated breadth. The tendency toward conservatism in endorsement of new rules to the Underwriters' National Electrical Association is very evident and commends the work of the association.

The sign committee's report during discussion brought out the general demand of members for final insertion of definite sign construction rules in the National Electrical Code proper. The use of single-braid wire and withdrawal of demand for spacing were endorsed by the association. The use of wood in sign construction was condemned. The 12-amp limit for

series multiple circuits of low voltage lamps was deemed necessary, but such systems were not generally believed extra-hazardous where on low-voltage circuits. The endorsed recommendations are to be presented to the Underwriters' National Electrical Association for consideration at its spring meeting, when action on sign rules in the "Code" will be taken.

The committee report on instructions to the public, which recommended that instructions be placed on or near electrical equipment, which has been found the only effective check on the abuses to which wiring is heir, was adopted. Overfusing and mechanical injury were most discussed and their special emphasis was recommended.

The committee report on theater wiring and show equipment elicited much discussion. The suggested amendments to sections of the existing "Code" rules were generally endorsed, as securing more definiteness and tending to cover more properly the requirements contemplated by the existing rules. The question of what constitutes a safe and convenient stage receptacle was much argued. Consensus of opinion favors open hole, but enclosed receptacle placed at side of the hole. Mr. H. C. Harris, theater expert with the General Electric Company, gave an interesting account of the problem involved and the manufacturers' difficulty in getting desirable uniformity of construction during the dissension of inspectors on the subject.

Some action to eliminate dangerous traveling-show equipment by communication of previous inspection reports to interested members was endorsed and the committee asked to formulate some definite plan.

RUBBER-COVERED WIRE.

The paper by Mr. Martin discussed fully the defects in commercial rubber-covered wire. He said that the low-grade and easily met original tests of "Code" rubber-covered wire have become a byword among manufacturers, jobbers and contractors alike. No one seems to have courage to take the initiative toward the formulation of effective specifications. Life is the main measure of quality and original cost, but while life cannot be tested for, quality can. Twenty-five per cent increase in original cost will secure practically unlimited life, and save the added expense in the average five-year maintenance, outside of the question of safety. The question obtains increasing consideration by architects and by builders, but the "Code" standard covers a multitude of sins in poor-grade competition. Specification for chemical, specific density, tensile strength, tests, and examination for character of application were recommended as a standard for approval, and a 30 per cent dry Para rubber with maximum allowable proportions of waxes, dry minerals, sulphide, etc., was recommended as a minimum specification.

Cheap oils and cheap rubbers reduce value in proportion as they are present, and extraction of resins does not restore quality. The high-potential tests were criticised except for sample lengths, because commercial quantities should not have their structure subjected to possibly permanent fatigue.

RESPONSIBILITY OF THE ELECTRICAL INSPECTOR.

In his paper on "The Legal and Ethical Responsibility of the Electrical Inspector" Mr. Rhine covered the general status of inspection work, the limitations in authority and responsibility of the inspector, his relation to city or underwriters as agent, and similar matters. The fiduciary nature of his position was emphasized. The lower demand for competency from municipal than from underwriters' inspectors was noted to be passing away. The qualifications for an ideal inspector were discussed. The paper went into the legal phases of refusal to allow connection to service, refusal to complete wiring, condemnation of defective new and old wiring. The particular case of old wiring formerly complying with law but now not complying was interesting, as proving that where installation is now dangerous to life or property, either from deterioration or from original faulty construction (though approved at the time), its condemnation is proper. Various authorities were quoted and interesting cases were discussed.

At the last session, which opened on the morning of Oct. 13, with the reading of the reports on "Induction Motors," "Law and Ordinances" and "Public Safety," it was voted, after much discussion, to recommend definite action on the fusing question, with tables compiled from experience, at the next meeting of the Underwriters' National Electrical Association committee on this subject. The same uniformity as has proven so advantageous in "Code" interpretation was found to be desired also for electrical ordinances, so far as municipal charters would allow. One very complete ordinance on motion-picture-machine theaters was submitted and considered. The confinement of theater wiring requirements to large auditoriums was criticised, and Mr. Tousley, of Chicago, recommended that "places of assemblage seating over 200" be made amenable to theater rules so far as they apply.

The report on "Public Safety" by Mr. Canada simply repeated former suggestions of the committee for abolition of ungrounded metallic surfaces in electrical fittings accessible to the public where other grounded surfaces are also present; continued campaign for grounded secondaries; the use of better publicity methods in hastening the adoption of safeguards by ordinance or otherwise. The necessity was shown for electrical inspectors, in the absence of other special inspectors, to note the fire and life hazard of gasoline lighting, where it exists, and to use publicity methods for its regulation by ordinance. Too often a species of discrimination exists against the safer electrical lighting by reason of exploiting its remote hazards while apparently not recognizing hazard in other more hazardous systems.

Upon the conclusion of discussion the nominating committee made its report and officers were elected as follows for the ensuing year:

Mr. V. H. Tousley, of Chicago, president (Mr. Tousley is well known, particularly as the author of several books on practice and problems in interior electrical installations); Mr. W. J. Canada, of Denver, electrical engineer for the Rocky Mountain Fire Underwriters, first vice-president; Mr. James Bennett, of Montreal, electrical engineer with the Canadian Underwriters' Association, second vice-president.

Visits to various theaters, the packing house district, the Fort Omaha wireless station and dirigible experimental station concluded the yearly program.

Chicago Meeting of the American Electrochemical Society.

The eighteenth general meeting of the American Electrochemical Society was held on Oct. 13, 14 and 15, in Chicago, Ill. This was a departure from established practice in two respects, firstly, because former fall meetings in recent years had always been held in New York City, and secondly, because the society went to the West for the first time. The success of the convention proved the justification of the selection of Chicago as the meeting place. The society has long ceased to be chiefly an Eastern organization, and, with its steadily increasing membership in foreign countries (which is now approaching 20 per cent of the total membership), it is now assuming an almost international character.

The attendance at all the sessions was very satisfactory. The last printed registry list contained 213 names. The mornings were devoted to professional sessions, the afternoons to visits and excursions, while on Friday evening a very enjoyable informal subscription dinner was held at the Congress Hotel.

A great many alternative excursions had been arranged, and all of them were well attended. Of especial electrical interest were visits to the Fisk Street power house and the Market Street transformer and storage battery station of the Commonwealth Edison Company, the works of the Western Electric Company, the Automatic Electric Company, the Washington and Franklin Street exchanges of the Chicago Telephone Company, the Lockport power station and the Drainage Canal. Concerning the latter and its relation to politics, some

interesting remarks were made by Mr. Harry McCormack in an after-dinner speech.

The visits of great metallurgical interest were the excursions to the South Chicago works of the Illinois Steel Company and the Gary works of the Indiana Steel Company. At South Chicago the 15-ton electric Héroult furnace—the largest one now in operation for electric steel refining—was seen in regular commercial operation. Considerable general interest was manifested in the visits to the packing houses with their allied chemical industries (manufacture of soap, butterine, etc.), and to the mail-order establishment of Sears, Roebuck & Co. The Hoskins Manufacturing Company had arranged an interesting demonstration exhibit of laboratory electric furnaces.

On the afternoon of Saturday the laboratories and the museums of the University of Chicago and the Field Columbian Museum were visited by part of the members. Of the three professional sessions, the Saturday session was held in the lecture room of the Kent Chemical Laboratory of the University of Chicago, while the Tuesday and Friday sessions were at the Congress Hotel. All arrangements had been made with great foresight and carefulness, and much credit is due to the local committee and especially to its chairman, Dr. H. N. McCoy, and its secretary, Mr. Arva B. Marvin.

The first meeting was called to order on Thursday morning by the president, Dr. William H. Walker, of the Massachusetts Institute of Technology.

THERMAL CONDUCTIVITY.

The first paper was presented by Mr. Carl Hering, and dealt with a method for determining the thermal conductivity of insulators, such as are used for electric furnace walls. The object of his arrangement is to avoid any leakage of heat sidewise from the test piece, and this is accomplished by so shaping the test piece that it has no lateral sides at all. In the ideally perfect form, use is made of a hollow sphere in the inside of which the heat is generated electrically; the heat then flows from the inside to the outside. When the stable state of heat flow has been reached the watts consumed for the production of heat and the two temperatures of the inside and outside surfaces of the sphere are measured. The thermal conductivity is then easily determined by simple formulas. It is, however, not practicable to use the test piece in form of a hollow sphere. Mr. Hering suggests, as the most convenient form of the test sample, a cylindrical cup rounded at one end and open at the other, and gives the formulas for this case.

The conductivity ascertained by this method is the correct average or effective mean for the range of temperature between the inside and outside temperatures of the sphere; that is, it is that conductivity which an equivalent piece of material would have whose conductivity is constant over the range of temperature, and which as a whole acts just like the sample.

In the discussion, in which Messrs. Richards, Browne and Lidbury also participated, Mr. Snyder called attention to a method used by Clement and Egy at the University of Illinois. They employed a long cylinder, the heat flowing from the inside to the outside. The method depends on the fact that there is no escape of heat longitudinally at the middle of the cylinder. The heat generated electrically inside and the outside and inside temperatures at the middle of the cylinder are measured.

FLOW OF HEAT THROUGH FURNACE WALLS.

In a paper on the flow of heat through furnace walls Mr. F. T. Snyder discussed first the rôle which heat connection and heat radiation play, especially in furnaces the walls of which are composite—that is, consist of layers of different materials. The radiation from the surface varies with the difference between the fourth powers of the absolute temperatures of the surface and the air, multiplied by a constant to deduce the results in Mr. Snyder's formulas to kilowatts of heat flow per square foot. This constant varies with the material of the surface and its condition.

For the flow of heat through the wall material an experimental constant is determined, giving the temperature drop in degrees C. through one inch of thickness of the material for a heat flow of 1 kw per square foot. This constant varies for any material with the temperature range for which it is determined. A table of this constant for various materials and various temperature ranges was given by Mr. Snyder.

The "contact resistance" to the transfer of the heat flow from one layer of material to the next is determined from an experimental constant giving the difference in degrees C. between the fourth powers of the absolute temperatures of the opposing surfaces for a heat flow of 1 kw per square foot.

For practical use curves are calculated giving the temperature drops for the common furnace materials and conditions under the different practical rates of heat flow. Such curves were given in the paper, together with tables of constants, and an example was added of the calculation of the temperature distribution through the bottom of a small steel furnace for two rates of heat flow.

Mr. Snyder's paper was discussed by Messrs. Frary, Hering and Richards.

REDUCTION OF TIN DROSS.

A paper by Mr. R. S. Wile dealt with the reduction of tin dross in an electric furnace. Electrical heat was resorted to for the smelting of tin dross because of the fact that the heat could be internally applied to the slag, which is on the bottom of a shaft type of furnace, thus enabling the dross to be thrown on top of the slag instead of being mixed with it as is done in the old style of furnace. The dross, being on top, comes in contact with the slag only at the point of reduction. The liberated gases filter through the dross, while any tin oxide which is volatilized is condensed in the colder portion of the dross, which is on top of the slag. The globules of tin produced in smelting pass downward through the slag and lose most of the impurities, so that very little refining of the resultant product is necessary.

A brief description of a commercial plant of this type was given. The furnace has two carbon electrodes, the upper being movable, the lower stationary.

CAST COPPER OF HIGH ELECTRIC CONDUCTIVITY.

A paper on cast copper by Dr. E. Weintraub, Schenectady, was then presented. The problem is to use a thorough deoxidizer which does not react or alloy with the copper. The usual deoxidizers, such as zinc, alloy with the copper, and while sound castings are produced, yet electric conductivity of the alloy is much lower than that of pure copper. Pure boron may be used, but it is cheaper to use boron suboxide, which is prepared by a modification of the reduction process of boric anhydride by magnesium.

Its action as deoxidizer is perfect, so that sound castings are obtained; on the other hand, the conductivity of the copper is not reduced, as is the case if zinc, magnesium, etc., are used as deoxidizers. The electrical conductivity obtained can be as high as 97.5 per cent if the copper melted down is perfectly pure. In the foundry, where the copper scrap which is melted down cannot always be very carefully selected, a conductivity of from 91 to 95 per cent is obtained, and a guarantee of 90 per cent is at present given.

The use of copper castings of this kind lies in two different directions. First, it can replace forged copper, whereby a great saving of cost is obtained. Secondly, it can replace alloys of copper, in which case the gain in conductivity allows the reduction in bulk and thus a saving in material.

Even in the past, in spite of the fact that cast copper has considerably lower conductivity than forged copper, in many cases cast copper has been used to eliminate riveted, screwed or soldered joints, whereby a number of poor contacts are avoided.

In the discussion which followed the great possibilities of this method were discussed by various speakers.

ELECTRIC STEEL REFINING.

Prof. Joseph W. Richards then delivered a lecture on the present use of the electric furnace in the iron and steel industries of Sweden and Norway, and especially on the Hiorth electric steel furnace which is in commercial operation in a plant in Norway. It is an induction furnace of modified con-

struction, there being two circular hearths in communication with each other in the middle, while a working hearth of considerable area is provided. The working hearth may receive additional heat, in a manner similar to that in the Roechling-Rodenhauser furnace, but this is not found absolutely necessary.

There is no refining done in this plant. Use is made of the same starting materials which are melted in Sheffield in crucibles, Dannemora pig iron and Dannemora soft iron. The electric furnace is simply used for melting these materials. The ingots are shipped to Sheffield. The steel is equivalent to the best crucible steel. The special field of this furnace is, first, for melting down high-grade material, and, secondly, for dead-melting ordinary open-hearth and Bessemer steel. A certain amount of refining can also be done in the hearth in the center.

TRIBOLUMINESCENCE.

The first paper of the Friday session dealt with triboluminescence, the author being Mr. W. S. Andrews. Triboluminescence is the property possessed by certain bodies of emitting light when rubbed or scratched. An artificial product of this kind may be easily prepared from 70 parts by weight of chemically pure zinc carbonate, 30 flour sulphur, and a trace of manganese sulphate. The method of preparation was described.

CALCIUM.

The electrolytic preparation of metallic calcium was the subject of two different papers. Prof. Arden R. Johnson in a paper described a series of experiments which he had made some years ago. He distinguishes two different methods—first, the apparatus of the Rorchers type for utilizing an extremely high-current density, and consequently obtaining the calcium in a molten condition, in which it rises to the surface and is skimmed off, and, secondly, the Rathenau type, which requires that the calcium come out in a compact form; that is, is plated out at a moderately low current density, and gradually removed from the electrolyte in form of a solid stick.

The author describes experiments which he has made with this latter method and difficulties which he has thereby encountered, and describes a modified apparatus in which a ribbon cathode was used. Considerable data were given on current efficiency and decomposition voltage curves. In the discussion which followed, Prof. Frary expressed the opinion that most of the difficulties of the author were due to the fact that he did not cool the cathode artificially.

A paper by Prof. Francis C. Frary, H. R. Bicknell and C. A. Tronson was then presented on efficiency in the electrolytic production of metallic calcium. It is produced in form of a cathode stick and gradually and slowly pulled out. Great care must be taken to pull the stick out with the right speed. The authors give the results of ten different runs, in none of which the ampere-hour efficiency was below 450, while in two runs it was 100 per cent. Plain calcium chloride seems a little more satisfactory as electrolyte than a mixture of the chloride and fluoride in point of efficiency, and is decidedly easier to manipulate. The ampere-hour efficiency obtained is largely a matter of careful regulation of conditions.

RADIO-ACTIVE ELEMENTS.

A paper by Prof. A. R. Johnson dealt with experiments on the electrolytic deposition of polonium and other radioactive elements. He also added some remarks on the bearing of Faraday's law on the fact that a very large number of coulombs is required to get a very small polonium deposit (not weighable, but only determined by radioactivity). In the discussion Dr. Kahlenberg pointed out that the direct application of Faraday's law would indicate that nothing but polonium was obtained at the cathode. Mr. Hering pointed out that the author experimented with an exceedingly dilute solution.

OZONE.

A paper by Mr. R. D. Small discussed the present status of ozone. The increased use of ozone in numerous European cities for the sterilization of water was outlined and a brief review was given of different commercial ozone apparatus. Heat and humidity are unfavorable conditions for the production of ozone. That is the reason why the electrodes are often cooled.

The author dealt at great length on the combination of ozonizers with fans for air purification. Carbon dioxide in air is only harmful as it replaces oxygen; it is not in itself harmful. It is only a danger sign as it indicates the presence of organic impurities. This organic matter is the dangerous element. While ventilation is necessary, yet outdoor air is not sufficient, as it does not destroy the organic matter. For this purpose ozone is required. The use of ozone as a deodorizer was dealt with. When ozone is used in air in the usual suitable quantity, which is small, ozone does not kill the bacteria directly, but by destroying the elements on which they live.

LEAD STORAGE BATTERY.

A paper by Mr. Pedro G. Salom dealt with the evolution of the lead storage battery. The first step was the Plante cell, with its great number of alternate charges and discharges, lasting for weeks and months. Then came the Faure-Brush type of cell as the second step; that is, the cell with a pasted active material and subsequent formation. Since 1881 there has been made no improvement over this type, except in mechanical details. The logical evolution is to go a step further, as has been done in the "initially formed cell" of the author. The active material is produced in bulk outside of the cell and applied mechanically to the grid, whereby the plate is finished. The author did not go in detail into the manufacture of the active material and plate, but compared the relative advantages of the Plante cell, the pasted cell, and the initially formed cell. The chief advantages of the latter are that the new plate, while remarkably homogeneous, carries a greater quantity of spongy lead and that the cost of producing the spongy lead electrolytically in bulk and applying it mechanically to the grid is less than the cost of an equivalent amount of litharge, as employed in actual practice.

The paper elicited considerable discussion, in which Messrs. Berg, Frary, Hepburn, Hering, Kohn and Salom participated. In reply to questions, Mr. Salvin said that no one knows yet what the life of the negative will be. It is probable that it will be as long as that of Plante cells; that is, ten years. The current capacity of the negative plate per ounce of active material is 2 amp. That means that about four times as much active material is put in as is theoretically required. This is about the same as in other properties.

Mr. Hering pointed out that the determination of the most economical life of a storage battery is quite similar to the determination of the economical life of an incandescent lamp. Both the depreciation of the battery and the cost of a new battery must be considered, and he agreed with Mr. Salom that a battery with a shorter life and lower price may be better than an expensive battery of longer life.

SELF-DISCHARGE OF BATTERIES.

The self-discharge of Plante and Faure storage batteries was the subject of a paper by Prof. O. W. Brown and W. G. Bowers. Comparative tests were made with various types of cells and the following conclusions were reached:

The Plante type of cell looses its charge when allowed to remain on open circuit for periods of from ten to twenty days. The Faure cell, when made from pure materials, suffers only very slight loss in capacity when left on open circuit; in every test the self-discharge of the Faure cell was much less than that of the Plante type.

The data of the authors also show that the Plante cell suffers permanent injury when considerable periods of time are allowed to elapse between charges, while one or two recharges of a Faure cell restore it to its original capacity.

In the light of these results the Faure type of cell is best suited for all service where intervals of a week to a month or more must elapse between charges. This condition is found in some telephone plants, in isolated lighting plants, and where cells are used for ignition purposes and for the operation of signal systems.

In the discussion which followed, and which also related to some points of Mr. Salom's paper, the Edison battery was referred to. Mr. Salom acknowledged that the Edison cell has an advantage over the lead cell in the number of watts per pound of total weight (including retaining jar, connections, etc.). The figure was given by Mr. Salom as 15 watts per pound for the Edison battery and 10 watts per pound for the lead cell. But Mr. Salom denied that the watt-hour efficiency of the Edison cell is 100 per cent better than that of the lead cell, as has been claimed. Dr. Gudeman pointed out that for certain purposes the available space is a consideration and that the power per weight per volume might be given as a characteristic figure.

OVER-VOLTAGE PHENOMENA.

A paper by Mr. Carl Hambuechen referred to the practical significance of the over-voltage phenomena. According to the electrolytic theory of corrosion, the corrosion of metals is caused by galvanic couples due to impurities or electronegative elements in the metal under consideration. Within limits, the electrochemical potential series will state whether a current will flow and in which direction. However, this is not the only determining factor, since the over-voltage phenomenon changes the situation somewhat. It means that to set free hydrogen gas at a metallic surface an excess voltage is necessary, and that this excess voltage or over-voltage differs for different metallic surfaces.

While the electrochemical potential table indicates that tin is as bad an element as is iron for producing corrosion of zinc, the correction for over-voltage shows that tin is far less harmful. And this is borne out by the facts in various practical instances. It is a matter of practical knowledge that iron or copper introduced as an impurity in dry cells is very harmful, producing rapid deterioration, while lead and tin (having high over-voltages) are almost harmless. This is fortunate, as otherwise the solder for making the seams would have to be prevented absolutely from entering the container and making contact with the electrolyte. The dry cell construction would therefore be more difficult and expensive.

A well-known household method of cleaning silverware of tarnish consists in placing the silverware in a zinc vessel and covering it by an electrolyte, such as baking soda, and salt. The tarnish is removed by electrochemical reduction, the zinc acting as anode and the silver surface as cathode. In studying this process the writer noticed that a zinc vessel, after being used thus a few times, lost its effectiveness owing to the formation of a high-resistance film on the zinc surface which prevents the silverware from making electrical contact therewith when resting upon it.

It was found that a grating of tinned iron wire soldered to the zinc entirely prevented this difficulty. The tin acting as the cathode surface is always maintained bright and chemically clean; owing to the overvoltage of tin, this is kept clean at the expenditure of a minimum amount of current. And when the silverware is placed upon such tinned grating it cannot avoid being placed in electrical contact, and the current generated by the dissolving of the zinc is concentrated upon the silver to the practical exclusion of the tin.

Several other practical applications of the same principle were quoted.

METALLIC FOOD CONTAINERS.

In a paper on the corrosion of metallic food containers, Dr. Edward Gudeman pointed out that in view of the fact that food products are now being condemned by food chemists for exceedingly small quantities of impurities contained (something like 0.001 per cent), the corrosion of metallic food containers with the result of impurities being introduced into the food has become a very serious matter. He has tried in various ways to produce a non-corrosive metallic food container.

The solubility of tin is small, but a complete uniform covering of iron with tin, without any pores, is impossible. The author has tried to impregnate iron with an exceedingly small amount of gold for protection. This is done by means of a gold amalgam, the mercury being subsequently distilled off; but while it can be done, the process involves considerable practical difficulties. He has also tried to enamel sheet iron with glass under pressure. This has been found possible, but not all difficulties have yet been solved. For instance, a fusible glass is required; this means lead glass, but lead is not wanted in food. The paper was stated to be only preliminary.

ELECTRIC FURNACES.

A paper read by Mr. Marcus Ruthenberg on the electric furnace and its applications was then presented. The author dealt with the history of electric furnaces, beginning with the old furnace of Siemens and discussed the advantages of alternating current over direct current for furnace operation.

As to the waste of electrodes, he stated that it was not all at the ends and that water-jacketing of the electrodes was very useful. He then referred to the usefulness of the electric furnace treatment for complex ores, such as nickeliferous iron ores, lead-iron-zinc ores, etc.

ELECTROSTATIC SEPARATION.

A paper by Mr. F. S. MacGregor dealt with the application of electrostatic separation to ore dressing. The system dealt with is that of the Huff Electrostatic Separator Company, which was described by H. A. Wentworth in the *Electrical World* on October 6, page 789. The new details given in Mr. MacGregor's paper are chiefly of metallurgical interest.

IONS.

A lecture by Prof. Robert A. Millikan on the isolation of an ion and a precision measurement of its charge proved one of the most interesting features of the convention. The method consists essentially in holding a given small droplet of oil (or other non-volatile substance) under observation for a considerable time, which may be four or five hours, and watching it catching ions from the air.

The oil droplet is introduced into the space between the plates of a horizontal air condenser charged from a large storage battery. In this space it will catch one or more ions which normally exist in air or which have been produced in the air between the plates by some ionizing agent. The movement of the oil droplet is observed when the field is zero and gravity acts alone. Its movement is also observed when the field exists. This is done repeatedly until the oil drop catches a new ion. In that moment the speed under the influence of the electrostatic field changes immediately, although its speed under gravity remains constant. From this change of speed the charge of the new ion which has been captured by the oil drop is determined.

Only very simple mathematics are required for this calculation, and no assumption is made except the correctness of Stokes' law, which is found to hold true if the drop is not too small. For sizes below a certain limit, Stokes law has been modified by Prof. Millikan.

Numerous determinations have been made by Prof Millikan with this method, and from the results, which are very accurate and agree exceedingly well together, it follows conclusively that electricity is granular or corpuscular in structure. All charges are built up of unit charges. The initial charge of an oil drop is always a multiple of the charges of the ions which it catches later on. It catches positive as well as negative ions. The charge of any positive ion is the same as that of a negative ion. The elementary charge is 4.9016×10^{-10} c.g.s. electrostatic units. The measurement of the ionic charge by this method is directly comparable with atomic weight determinations.

In the brief discussion which followed, Prof. Millikan was enthusiastically complimented on the success of his measurements. The apparatus used by Prof. Millikan was afterward shown and demonstrated by him in the physical laboratory of the University of Chicago.

PHYSICAL CHEMISTRY RESEARCH.

The last three papers of the convention dealt all with important research work on physical chemistry carried out at the University of Wisconsin. They were presented in abstract by Prof. Kahlenberg. A paper by Dr. J. H. Walton dealt with the phenomenon of crystallization through membranes. Super-

saturated solutions are used on both sides of the membrane. When crystallization is started on one side it sometimes continues to expand to the other side. In other cases it does not.

A paper by Dr. Louis Kahlenberg himself dealt with the relative basicity of the metals as shown by their power to replace one another in chemical compounds. In aqueous solutions there is an arrangement of the metals in a certain series. But when such a series is formed according to the results obtained with non-aqueous solutions the arrangement of the series is entirely changed.

A paper by Dr. David Klein dealt with the effect of water in causing chemical reactions. It has often been claimed that water is a unique substance, in so far as its presence is necessary to cause certain reactions. However, Dr. Klein's research shows that the position of water is not so unique.

The next meeting will be held in New York in the spring of 1911.

Convention of the Electric Vehicle Association of America.

The Electric Vehicle Association of America held its first annual convention in the Concert Hall of Madison Square Garden, New York City, on Oct. 18. Seldom have national bodies launched their first public sessions under such auspicious circumstances. The attendance was approximately 250, and the program such as to hold the attention of all those present during the morning and afternoon sessions. Prior to the delivery of his address President W. H. Blood, Jr., expressed the debt of gratitude which the association owed to Mr. Arthur Williams, of the New York Edison Company, to whom was due in a large measure the phenomenal success which thus far has attended the deliberations of the infant organization. Mr. Blood then invited Vice-President Williams to take the chair while he read his address.

PRESIDENT BLOOD'S ADDRESS.

President Blood in opening his address said that he had no apologies to offer for the modern electric vehicle, for none are needed; but the unsatisfactory record made by the earlier vehicles of some ten years ago has resulted in an unfortunate prejudice which must be overcome. Wonderful progress in the development of the electric vehicle has been made in the past few years, but there has been little or no effort made to tell the public of the changed conditions. The need, therefore, of an association to correct these conditions, and to enlighten the public, is self-evident. The idea of the association originated in Boston, where the New England Association was organized March 11, 1908. It became apparent, however, that the movement to be of the greatest value must be national in scope, and consequently the Electrical Vehicle Association of America was incorporated Sept. 1, 1910, with a charter membership of twenty-nine, to which has been added the New England membership of ninety-one, making a total of 120. The Pacific Coast Electric Vehicle Club and a similar organization in Chicago are already seeking affiliation. The matter of securing new members will be undertaken immediately by a carefully selected committee, and regular monthly meetings will be held in New York for the reading and discussion of papers and reports. Provision is also made for the formation, in centers of local activity, of branch organizations. There will be a large fund by means of which to advertise all over the land that the electric vehicle is a perfected device and that it can and does perform certain services better and cheaper than any other agency.

Among the work coming within the scope of the association is that of standardization, as, for example, the adoption of a standard charging plug; the selection of standard motor voltage, securing uniformity in the size of batteries; the adoption of a standard type of chassis, uniformity in the gage or track of cars, and an agreement on the principal dimensions of a one-ton, two-ton and five-ton truck. Moreover, manufacturers of electric vehicles should be encouraged to get together and agree upon a small number of standard tires to be used on electric vehicles, thus making it easier for the customer to use such vehicles, and simpler for the garage to carry a proper stock of tires. The association might also with benefit undertake the publication of an electric vehicle "Blue Book," giving a list of charging stations and rates for electrical energy in the various cities and towns throughout the country, and include a list of responsible garages which did not differentiate against the electric in favor of the gasoline car. It was suggested that manufacturers should, for a time at least, have in each large city a paid representative who should be primarily a battery expert, and also a good mechanic, who would go from garage to garage and customer to customer giving free advice and assistance, and doing whatever possible to obtain better service from the electric vehicle and so increase its adoption and use. The association has also an opportunity to see that the installation of charging plants in garages and elsewhere is taken up in a systematic manner, and some method of financing should be devised for the worthy garage handicapped by limited capital. Broadly speaking, it should be the aim of the association, through its members and committees, and by every legitimate means, to make it so easy and simple to operate electric vehicles that prospective users may have no valid excuse for not purchasing electric cars.

Having assumed that all of the above has been accomplished the time may come when an association—perhaps the present one—would take up the question of the universal exchange of batteries. An entrance fee, dependent upon the cost of batteries, would be required, and yearly dues covering the average cost and maintenance and depreciation of the battery would be charged; then the individual user would pay for the energy which he used at standard rates, and a recharged battery could be had at all official stations supported by the association. While this may be somewhat visionary and not possible of solution, it can already be seen that where electric cars travel over regular routes of considerable length a system of relay batteries ready for instant use could and would be easily established, and the general exchange of batteries would simply be carrying this idea one step further.

Mr. Blood stated that while the present prices of electric vehicles are not as low as they should be, with the manufacture of standard machines in larger quantities a material reduction should necessarily be the result. The price of batteries is tending downward, and from the increase in mileage very satisfactory results are now obtained. The handling of batteries is becoming simplified, and they are rapidly approaching a condition of being practically "foolproof." Rates for charging batteries are not at all uniform, but great progress has been made in adjusting these rates and in making them commercially reasonable.

There is, however, room for further revision along all of these lines, but by proper effort the electric vehicle can be made a still more attractive proposition than it is now. It is to such work that the association will address itself. The modern electric vehicle is a commercial success; the public is ready to use the car and has the wherewithal to pay for it. The duty of the association is to bring these two interests together; in doing this the cars are sold, the batteries installed, the central-stations' energy used, and everyone reaps the benefit, including the user, who gets both pleasure and profit from the transaction.

At the conclusion of the address Mr. Williams said that it contained information and suggestions of such importance that it should be published broadcast for the benefit of central stations and electric vehicle manufacturers. Mr. Hayden Eames, of Cleveland, moved that the matter be referred to a committee of three, who were afterward appointed as follows: Messrs. Hayden Eames, W. C. Anderson and F. W. Smith.

PROMOTING THE ELECTRIC VEHICLE.

In a paper entitled "Problems Involved in Advancing the Use of Electric Vehicles" Mr. William P. Kennedy gave an account in extenso of the historical development of road vehicles from the time of the Egyptians to the present day.

The advantages of the electric vehicle were then pointed out, and the obstacles in the way of its use reviewed. Heretofore, it was stated, almost the entire burden of introducing the electric vehicle has been carried by the manufacturer. The educational value of instructive literature was dwelt on, and also the influence of the electric pleasure vehicle in aiding in the introduction of the commercial vehicle. The type of the desirable salesman was sketched, and also methods which he should use in presenting his case. The long and persistent effort to awaken the central station to a realization of the important and profitable share it should take in the electric vehicle movement had, he said, culminated in the organization of the present association, but there remains the evolution of practical, extensive and effective plans of procedure, including dissemination of information, and the execution with determination of a program which will be as irresistible as it may be comprehensive.

There was no discussion on this paper and the next paper on the program was taken up without delay. This paper by Mr. F. L. Dyer, of Orange, N. J., was preceded by a motion-picture film illustrating the experiences of a purchaser of a gasoline car and also of a horse-drawn carriage and their final adoption of the electric vehicle. The picture-story was well told, and the new method of advertising electric vehicles is certain to meet with widespread adoption.

ELECTRIC VEHICLE PERFORMANCES.

"Recent Electric Automobile Performances with the Edison Storage Battery" was the title of a paper presented by Mr. F. L. Dyer, of Orange, N. J., in which an account was given of a series of one-day trips covering the country around and about New York City, each trip calling for the accomplishment of from 85 miles to 100 miles on a single charge of the Edison battery. An account in detail was given of the trips made by cars entered by the S. R. Bailey Company, Amesbury, Mass.; the Anderson Carriage Company, of Detroit; the Baker Company, of Cleveland, and the Babcock Company, of Buffalo. The first run was made by the Detroit car, the distance being 84 miles, at an average speed of 12.07 miles per hour, over freshly tarred roads with grades as high as 9 per cent. Excess battery capacity subsequently run off showed a safety surplus of 18 miles, making a total of 102 miles on a single charge. The second run was made by the Bailey car, the total mileage being 76, at an average speed of 13.19 miles per hour. The excess mileage run off showed a surplus of 40 miles, making the total for the day 116 miles on a single charge. On some parts of this run grades of 10 per cent were frequently met. The three other cars made records of, respectively, 122¼ miles at a speed of 12.38 miles per hour; 139½ miles at 13.71 miles per hour, and 113 miles at 12.47 miles per hour. One test consisted in running a vehicle for an hour and a half per day for a week in Central Park on a single seven and one-half hour charge at normal rate. In this test no water was given to the batteries, and for the seven days the charging socket was sealed. At the end of the week the odometer reading was 120 miles at an average speed of 12.32 miles per hour, and the cost of electricity was $1.42, or 21 cents per day for a trifle over 18 miles.

Another trial consisted in climbing Fort George Hill, the length of ascent being 2138 ft. at a grade of 11 per cent. The car made twenty-one successful trips up the hill under a single charge of the battery. This particular performance meant a climb of almost one mile into the air in eight miles, to say nothing of going up a grade for nine miles from the garage to reach the hill. Another trial consisted in circling the State of New Jersey, making charging stops at Asbury Park, Atlantic City, Philadelphia, Bethlehem, Port Jervis and Newburgh. While the roads in New Jersey were in good shape, those in Pennsylvania were bad, the grades were heavy and full of short water breaks. The daily runs by the two cars varied between a minimum of 54 miles and a maximum of 94 miles, in every case on a single charge. The total mileage was 489. Next it was decided to attempt the "ideal tour" of approximately 1000 miles, a route familiar to many automobilists over roads along Long Island Sound, through Massachusetts into Vermont and New Hampshire, thence to the Maine coast, down through Boston and return to New York. The paper gave full details of this trip, which was undertaken by two cars. One car showed a total mileage of 1017.99 miles at an average speed of 11.77 miles, and the other car a total of 1017.75 miles, with an average speed of 11.35 miles per hour.

THE OBLIGATIONS OF THE CENTRAL STATION.

A paper by Mr. Louis A. Ferguson, of the Commonwealth Edison Company, entitled "Relation of the Central Station to the Electric Vehicle Industry" was then read by its author, who commented on the slowness of central-station managers to recognize their relations to the electric automobile industry. He said it was unjust to the customer and bad business practice for central-station managers to advise the use of electric vehicles for certain purposes and after they have been placed in service to give no further attention to the matter other than to collect the bills for electricity consumed. He maintained that the central-station company is one of three interested partners, the other two being the vehicle manufacturer and the user. Progressiveness on the part of the builder should be met with tolerance on the part of the purchaser, and the central station should not only supply energy at a reasonable rate, but should also assume that it is to a large degree responsible for the efficient operation of the vehicles. The author dwelt on the responsibility of the central station in the premises and maintained that an expert battery engineer should be employed who should investigate all cases where more energy is being used than seems warrantable. This gratuitous service is certain to be rewarded by greatly increased revenues to be derived from the sale of energy to electric vehicle owners. Moreover, the central-station company owes it to itself and to its customers to set an example and establish proof in its own locality that the electric vehicle is serviceable, reliable and economical when considered from the viewpoint of the user. Investigations made in Chicago show actual costs of operation, including electrical energy at 4 cents per kw-hour, supplies, tires, battery and all other repairs, but exclusive of fixed charges and antiquation, of 6 cents per mile when averaging thirty miles a day. It is unusual for the 1½-ton wagons to use more than 3 amp-hours per mile while running under average conditions. These figures, Mr. Ferguson maintained, demonstrate that the electric commercial truck is capable of meeting practically all requirements of the average user and in addition furnishes him with more economical, cleaner and all around better service than can be obtained from either of its competitors. The author showed that from statistics of his company the average monthly income from a 3000-lb. electric trucks is $12, from a 5-ton truck $20, from freight elevators $20 and from passenger elevators $40. He pointed out that central-station managers would be keen to get an elevator load, whereas actual experience shows that the electric truck gives as great an income and a better load-factor. Battery questions need no longer frighten the buyer, and the mileage range of a vehicle is sufficient for all city demands. The indisputable facts regarding the electric vehicle should be taken by central-station managers to those who ought to use the vehicle, because the day is past when no economy can be shown. Mr. Ferguson concluded with the statement that central-station customers expect the central-station manager to furnish them with reliable data as to cost of operation and maintenance of electric vehicles and unless he can supply this information first hand his statements do not carry sufficient weight to interest a prospective purchaser to the point of buying an electric vehicle. It is essential that its friends do something to pave the way, because there is no surer way to retard the growth of electric vehicle business in a city than for the company itself to fail to make use of them. Merchants cannot be blamed for being skeptical under such conditions.

USES OF ELECTRIC VEHICLES.

Mr. Day Baker, of Boston, then presented an illustrated

paper showing various applications of electric vehicles. Various vehicle manufacturers were invited to send pictures of installations, and as a result a very great number of slides were shown embracing every field of endeavor. Mr. Baker gave short descriptions of each installation and while giving credit to the various manufacturers whose cars were illustrated by stereopticon studiously refrained from mentioning the name of his own company when its product was illustrated. The author felt that the pictures would leave a better and more lasting impression on the minds of those present than the mere recital of the uses to which the vehicles were put. Mr. Baker's paper was followed by the final paper of the morning session, that of Mr. J. T. Hutchings, of the Rochester Railway & Light Company.

THE ELECTRIC TRUCK.

Mr. Hutchings in his paper, which was entitled "The Electric Vehicle in Heavy Trucking Service," stated that there are in operation to-day something over 600 3½-ton to 5-ton electric vehicles in certain mentioned lines of trucking, a considerable number of which have been in use from eight to ten years and are still giving satisfactory service. After discussing the best speed for heavy trucks, the conclusion was arrived at that it is a fallacy to drive them faster than eight miles an hour under our conditions of poor pavements, congested traffic and with the tire problem as it now stands. The possibility of handling trucks of larger capacity than 5 tons is merely a question of tire maintenance and the making of a vehicle which can be safely handled in our crowded streets. Mr. Hutchings states that the present cost of the up-keep of rubber tires on 7½-ton to 10-ton vehicles is so high that lighter trucks would undoubtedly prove less expensive in the total cost of the delivery of merchandise. The question of batteries in connection with heavy trucking is not a serious one. It is no longer difficult to get a man of sufficient experience and ability to take care of batteries in a satisfactory and sane way. Mr. Hutchings believes that it is directly up to the battery manufacturer to supply battery engineers to the users of vehicles. The cost of electric energy for the charging of storage batteries is a very small item, as a 5-ton truck will seldom cost more than $1 per day for electricity at the rate of 4 cents per kw-hour. Taking up the viewpoint of the central station, it is stated that a 5-ton electric truck is equivalent in earning capacity to twenty-one commercial arc lamps or 1000 incandescent lamps or 179 flatirons. With a product which is satisfactory to the user, manufacturer and central station, Mr. Hutchings sees no reason why the future of the electric truck in the transportation of heavy merchandise and material is not assured.

Following the presentation of Mr. Hutchings' paper in abstract, announcement was made that the New York Edison Company had invited the entire assemblage to lunch in the restaurant in the Garden below, and also had provided tickets of admission to the Electrical Show for all those who cared to inspect it after the convention had adjourned. Covers were spread for over 250 and a most enjoyable repast was served.

A complete account of the afternoon session, together with the discussions which took place at that session, for all discussion was reserved for the afternoon session, will appear in the next issue.

Increasing Importance of the Electric Vehicle.

In the course of an address before the Electric Club of Chicago, on Oct. 12, Mr. F. J. Newman, works manager of the Woods Motor Vehicle Company, said that he believed the time is not very far distant when there will be as many electric automobiles as gas cars made and sold.

It is true that the gasoline automobile has the touring field pretty nearly to itself. Here the electric vehicle is not a dangerous competitor, and possibly never will be. But in 90 per cent of the work for which all automobiles are used the electric car can, on the whole, give more satisfactory service than its rival.

Central-station managers will observe that the electric vehicle is an off-peak proposition. It is true that there are many isolated plants in garages, but as the number of electric automobiles increases, and as a more careful study is made of the subject of supplying electric energy for them by owners, garage proprietors and central-station men, there will be an increased load of this description taken by the central stations.

Mr. Newman believes that the high standard of electrical appliances has been brought about to a very large extent by the specialty manufacturer. The latter might well give his attention to devising an apparatus that would find a wide field of usefulness in the electric automobile industry. This is an instrument which would reveal, more nearly than is practicable at the present time, the available amount of electrical energy in the battery at all times. A voltmeter, with the aid of a thermometer, tells something, but in the speaker's opinion the amp-hour meter is of little use without the aid of a hydrometer. In the case of the hydrometer, again, it is difficult to obtain readings from it in actual practice in operating cars. Therefore, there is an opportunity for the specialty manufacturer to devise an apparatus combining in one appliance all the good qualities of the instruments mentioned without their drawbacks.

The electric automobile industry makes business for the manufacturers of rectifiers and switchboard apparatus and the contractors who install them. Motors, wire brushes and other electrical parts are also required. Mr. Newman said that there is a tendency in the manufacture of sockets to adopt the bayonet type rather than the screw type, as the latter has some tendency to allow the lamp to jar loose. This is especially the case in relation to incandescent lamps used in automobiles.

Brief reference was made to the Edison storage battery, which the speaker thinks still remains to be proved. It was predicted that the manufacturers of lead storage batteries will make great strides in the next few years. The principal drawback of the lead storage battery is its life, or rate of depreciation. Improvement in this respect will give better weight efficiency, which is especially desired for batteries used on vehicles.

Answering a question in relation to the use of the electric car in touring Mr. Newman said that high mileage in automobile operation depends to a great extent on low speeds, thereby reducing wind resistance, which varies as the square of the speed. Big motors and batteries are needed to obtain high speed with electric vehicles, and speed is of importance in touring.

In relation to the comparative cost of operation of electric and gasoline cars Mr. Newman referred to a recent commercial-vehicle run in Philadelphia, where gas and electric vehicles, both delivery cars and trucks, were tested under comparative conditions. In this case more prizes were awarded to electric vehicles for economy in hauling live weight than to the gasoline machines. The recent decision of Gimbel Brothers, of New York, to employ nearly all electric delivery wagons for their large retail store was also mentioned.

Among those who took part in a brief discussion, which brought out some of the foregoing points, were Messrs. O. B. Duncan and James H. Delany. Mr. A. A. Gray gave some account of his observations on a recent trip to the Pacific Coast, and Messrs. F. P. Vose, Max Zabel, T. G. Grier and Mr. McCullough, of the Great Northern Power Company, of Duluth, also spoke briefly. A vote of thanks was tendered the speaker.

Ontario Receives Niagara Power.

To Berlin, Ont., belongs the distinction of being the first city in the world to receive electric energy transmitted over 100 miles at a potential of 110,000 volts. The official turning on of Niagara power received over the lines of the Hydro-electric Power Commission of Ontario took place at Berlin on Oct. 11 and was followed by a three days' celebration in

which the completion of the first section of the greatest public undertaking in the history of the Dominion of Canada was fittingly signalized.

Myriads of incandescent lamps were strung along the main thoroughfares, and together with electric arches and signs, transformed Berlin for the time being into an electric city. In Auditorium Rink a fine display of the most modern electrical devices, including power supplies, cooking and heating apparatus, was made by prominent Canadian and American manufacturers. This building was chiefly lighted with tungsten lamps and showed to advantage when the official button was pressed by the Premier of Ontario, Sir James Whitney, and the Hon. Adam Beck, chairman of the commission.

In the evening a banquet was given in honor of the occasion and was largely attended by electrical men from all parts of the province. A distinctive and pleasing feature of this affair was the use of electric cooking in the preparation of the different courses of the menu.

Speaking at the opening ceremonies the Hon. Adam Beck, chairman of the commission, reviewed the progress of the cheap power movement in Ontario which had led to the government undertaking the project on behalf of the people. Referring to the actual engineering and construction work, he warmly praised Chief Engineer P. W. Sothman and his staff of assistant engineers, whose services he felt had been particularly efficient. Identified with Mr. Sothman in this enterprise were the following engineers: Messrs. F. A. Gaby, chief assistant engineer; H. G. Acres, assistant engineer in charge of hydraulic and transmission line work; E. T. J. Brandon, assistant engineer in charge of substation work; A. E. Davidson, in charge of substation construction; F. B. Manshendell, insulator expert; P. B. Yates, J. A. Brundidge and F. T. Stocking. Mr. R. A. Ross, of Messrs. Ross & Holgate, Montreal, was consulting engineer to the commission.

With a view to investigating the possibilities of obtaining cheaper electrical power a movement was started by a number of prominent manufacturers in Western Ontario and from the interest created the Hydroelectric Power Commission of Ontario came into existence. In 1905 it was incorporated by the Legislature and power was given to construct works for the transmission and supply of electrical energy.

March, 1908, saw the completion of an agreement between the commission and the Ontario Power Company, of Niagara Falls, which latter company agreed to supply up to 100,000 hp

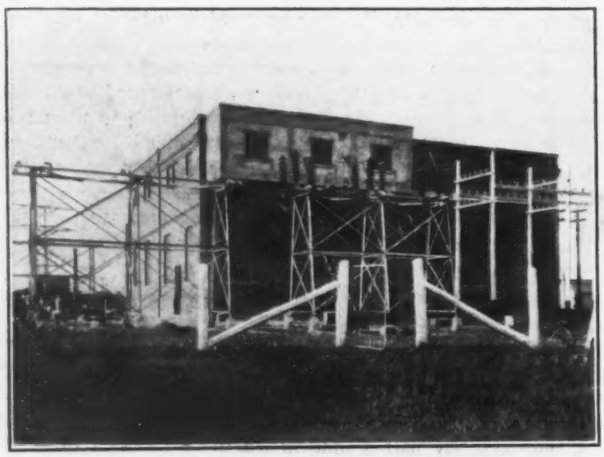


Fig. 1—110,000-Volt Substation at Berlin, Ont., Can.

at 12,000 volts, to be paid for at the rate of $9.40 per annual horse-power for the first 25,000 hp and $9 thereafter.

Preliminary surveys were made for a transmission line taking in the cities and towns of Western Ontario which had contracted with the commission for a supply of power. It was at first the intention of the engineers to transmit the power from Niagara Falls at 60,000 volts, three-phase, and with a frequency of 25 cycles, but subsequently it was decided to raise the voltage to 110,000. In all twelve stations were constructed as follows: Step-up transformer station at Niagara Falls; step-down station at Toronto; main interswitching station at Dundas and interswitching and transformer stations at Guelph, London, Preston, Berlin, Stratford, St. Mary's, Paris and Woodstock.

On the line between Niagara and Dundas No. 4-0 stranded aluminum cable was used and No. 3-0 on the rest of the line. At Dundas the line divides into two circuits and is so arranged that in case of accident to the line at any point current can be

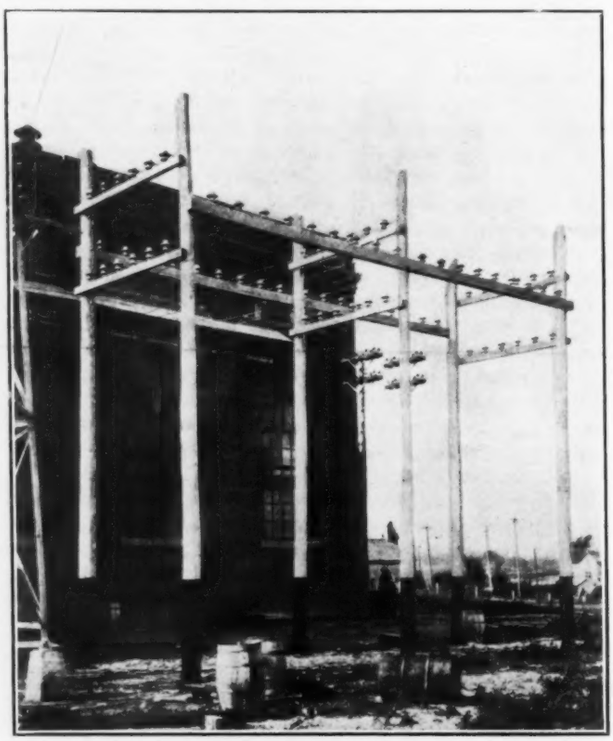


Fig. 2—110,000-Volt Substation at Berlin, Ont., Can.—Outgoing Lines.

fed around the loop in the opposite direction and the service continued without interruption. In conjunction with the power lines, which are practically double-circuited throughout, a telephone system has been installed paralleling the transmission line. The telephone line also carries a protective relay system which in the event of any lines becoming broken, grounded or short-circuited automatically cuts off the high-voltage circuit. This is effected by a balanced system of currents which become disturbed, causing a current to flow when trouble of any nature strikes the line, instantaneously disconnecting each end of the dangerous section.

In laying out their lines the engineers have paralleled the roadways as much as possible and all crossings are protected by mesh construction. The towers used in this work are of light yet substantial design and were tested thoroughly before being finally adopted by the commission. The normal span between towers on the level is 550 ft. The whole tower line is about 276 miles in length and approximately 3000 towers were required for the work of construction. At the end of the Toronto line difficulty was met in obtaining a right-of-way into the city, and as a result the engineers were forced to erect twenty towers along the waterfront and these were placed on massive concrete piers.

Providing insulators for the 110,000-volt line was no small task. Tenders were called for and manufacturers were asked to meet the most rigid specifications. The suspension type of insulator was adopted and these were required to withstand a dry potential test of 330,000 volts and a wet test of 220,000 volts, with ½ in. of rain per minute at 45 deg. angle toward

the insulator. The strain insulators, used on all angles, transpositions and long spans, were compelled to withstand 10,000 lb. without breaking. The first contract for insulators was placed with the Ohio Brass Company, but some of the later insulators were purchased in Germany.

The contract for the construction and erection of the high-tension line was awarded to the F. H. McGuigan Construction Company, which was the lowest tenderer and which agreed to build the line according to specifications and to supply all the materials except insulators. The contract price was $1,270,000 and called for the execution of the work not later than July, 1910. Unfortunately there have been delays in supply of materials and on questions of right-of-way which have made impossible the completion of the line by the date set.

The contracts for the electrical equipment for the different stations were let early in 1909. On account of the pioneer nature of the work it was deemed advisable to consult with several of the prominent power transmission engineers before awarding contracts, and the services of Messrs. R. A. Ross, V. G. Converse and Ralph D. Mershon were accordingly obtained. Visits were made to the works of the companies tendering for the supply of equipment, and contracts were finally made with the Canadian General Electric Company for the supply and installation of the necessary equipment for the stations at Toronto, London, Guelph, Preston, Berlin, Stratford, St. Mary's, Woodstock and St. Thomas, with the exception of the 110,000-volt line switches, which were supplied by the Canadian Westinghouse Company in the above-mentioned stations. This company also supplied the complete equipment of the Niagara and Dundas stations, and installed the protective relay system to cut out automatically defective portions of the line without disconnecting the supply of power at any distributing point of the system.

During the summer of 1909 Chief Engineer Sothman and one of his assistant engineers visited Europe for the purpose of collecting data and latest information on European practice in construction and equipment of high-tension power transmission lines. They also studied the conditions abroad pertaining to the general use of electric power appliances and machinery which eventually could be introduced to further the more general adoption of electric power in the Province. On this trip information of a most valuable character was collected and tabulated.

In conclusion, it may be pointed out that the work of the Hydroelectric Power Commission of Ontario extends over a wide area. The completion of the lines in Western Ontario will soon be an accomplished fact. Other parts of the Province are, however, clamoring for the commission's supervision of water-powers. Already the Hydraulic Department has estimated the water-power resources of the Province, storage areas have been surveyed and reported on, and in the case of Dog Lake, situated in the northern part of the Province, plans for increased storage capacity have been drawn for the Department of Public Works and construction work placed under way. In the east, Ottawa, the Canadian capital, is securing a power supply at a comparatively low rate through the interests of the commission, while many other towns are making application for a similar service.

McCall Ferry Plant Begins Operation.

The large hydroelectric plant which the Pennsylvania Water & Power Company has been building for a number of years at Holtwood, Pa., better known as McCall Ferry, was placed in operation on Oct. 14 and electrical energy was transmitted over its lines to Baltimore, Md. At the station the lines cross the Susquehanna River by a span over 2000 ft. long on towers 120 ft. high, and just east of Baltimore the lines cross the tracks of the Baltimore & Ohio Railroad on 120-ft. towers. At present two wheels are in operation and all of the energy is being transmitted to the Consolidated Gas, Electric Light & Power Company of Baltimore. The contract with the latter company calls for the delivery of a maximum of 15,000 hp the first year, and this amount will be increased yearly during the life of the contract.

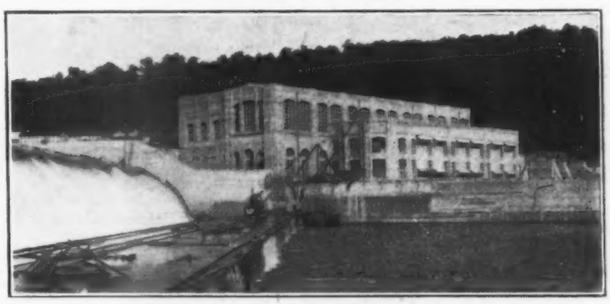


Fig. 1—Down-Stream Side of Power House.

The hydroelectric development of the Pennsylvania Water & Power Company is located on the Susquehanna River about 10 miles northwest of the boundary line between Pennsylvania and Maryland, and about 20 miles from the tidewater of Chesapeake Bay. There are steep banks on either side of the river at McCall Ferry with an island in midstream, and a narrow gorge between the eastern bank and a chain of islands form a natural tail race. A fall in the river due to a series of rapids above the site makes available for hydraulic purposes a total head of about 63 ft. The dam across the river is approximately half a mile in length and is said to be the second longest dam in the world. It is built of solid concrete with an average height of 55 ft. and a width at the base of 65 ft. The down-stream face is provided with the usual curve, and to allow for expansion and contraction layers of compressible material are introduced at intervals of 40 ft.

The power house, which is also built of solid concrete and connects the eastern end of the dam to the shore, is 500 ft. long. Provision is made for ten units, with a total maximum rating of 135,000-hp. To guard against ice, elaborate precau-

Fig. 2—Forebay of the Pennsylvania Water & Power Company's McCall Ferry Station.

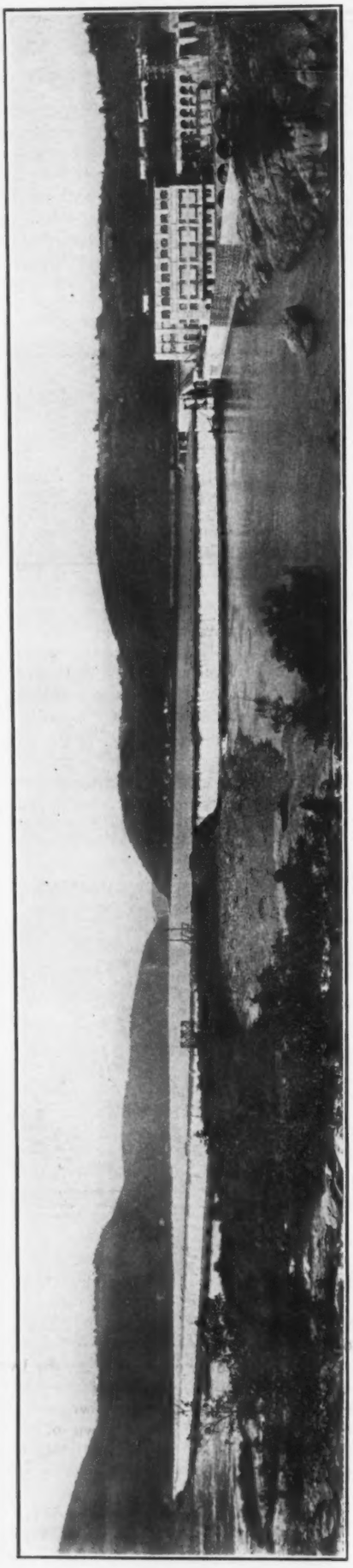


Fig. 3—Panoramic View of the Hydroelectric Development of the Pennsylvania Water & Power Company on the Susquehanna River at McCall Ferry, Pa.

tions have been taken. The normal flow of the Susquehanna River is westward, thus carrying most of the ice away from the power house. In addition a wing dam, having three submerged arches through which the water enters the forebay, is built at right angles to the main dam, between which and a rock fill above floating booms are provided so as to divert such ice as is carried to the east over the spillway. Any ice which enters the forebay despite these safeguards, as well as ice which may form there, is diverted through three ice chutes built into the power house. Some conception of the massiveness of the structures which characterize the plant is conveyed in the accompanying illustrations.

The water wheels are of the vertical type, each capable of developing 13,500-hp when operated at 53 ft. head and with 80 per cent gate opening. Two wheels are mounted on a single shaft of forged steel, and the entire weight is carried on a roller bearing supported by a casting set into the masonry. The arrangement for operating the gates consists of a vertical shaft made of pipe carried on a step and held at the top by a bearing attached to the wall. The maximum velocity of flow of the concrete openings is 6 ft. per second, and all changes of direc-

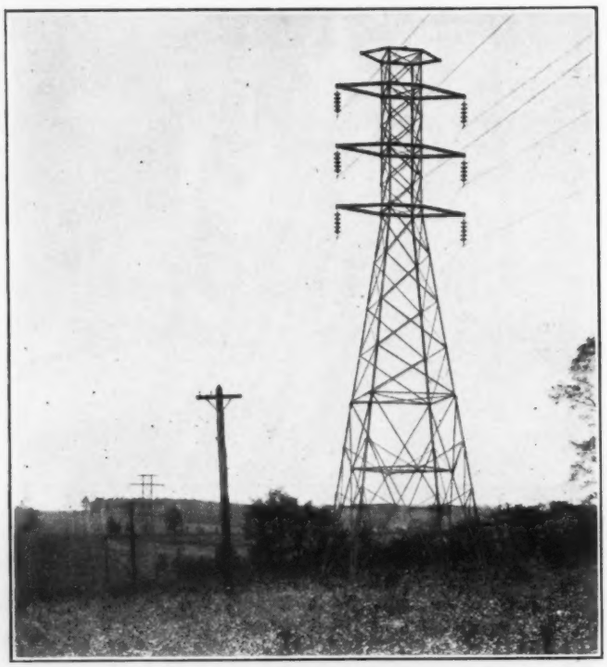


Fig. 4—Transmission Line to Baltimore, Md.

tion of flow have been made as gradual as possible so as to conserve the head. The draft tubes of the upper and lower wheels come out together below the level of the standing tail water, so that it is possible to get at the upper turbine by closing the head gates. When the lower turbine requires attention, stop logs may be used to cut off the tail race and the draft tubes drained by electric pumps. The water wheels were built by the I. P. Morris Company, of Philadelphia. Each wheel is coupled to a 7500-kw, three-phase, 25-cycle General Electric generator operating at 94 r.p.m. The design is such that with the available head reduced to the possible minimum during extreme floods the generators are capable of giving their rated output with 100 per cent gate opening.

The hydraulic plant is now completed for an initial installation of 50,000-hp and an ultimate installation of 100,000-hp. The power house, gate house and transformer house are finished for six units, including rheostat and switchboard galleries, compartments for transformers and other apparatus. At the head works foundations, etc., are completed, the only work required to prepare the power house for the full installation of 100,000-hp being the completion of the superstructure. As stated above, two units are already in operation, and

three other units will be installed as rapidly as they are received from the manufacturer.

Transmission line No. 1 is complete and ready for service. There are 500 steel towers, ranging in height from 40 to 60 ft., carrying two 70,000-volt circuits each of three aluminum cables. The company owns title to a right-of-way 100 ft. wide and 40 miles long, extending from the Susquehanna River to the City of Baltimore, and a private telephone line is installed the entire length of the transmission system. The substation at Baltimore has been ready for operation for several weeks, and the transformer and auxiliary apparatus installed is sufficient to handle 40,000 hp. The station is designed and equipped to receive, transform and distribute energy most economically, and provision is made for additional apparatus, so that the output may be doubled when the demand for energy justifies the installation of additional apparatus. The equipment in the Baltimore substation was supplied by the Westinghouse Electric & Manufacturing Company.

As the result of damming the Susquehanna River a great body of water has been impounded, which forms a lake above the dam about eight miles in length. To protect the company against claims on account of flooding property along the river, it was necessary for it to acquire large tracts of land on both sides of the Susquehanna. This property adjoins the lake which has been formed, and it is the purpose of the company to dispose of it for commercial or other purposes, the Pennsylvania Water & Power Company merely reserving enough real estate to protect its rights.

The contractor for the installation was the Empire Engineering Corporation, which worked under the supervision of Mr. John A. Walls, chief engineer of the Pennsylvania Water & Power Company.

McCall Ferry Power at Baltimore.

On Friday of last week Mayor Mahool, of Baltimore, turned on the power generated by the Susquehanna River at McCall's Ferry in the presence of a party composed of financiers from Baltimore, New York, Philadelphia and elsewhere. Electrical energy at 70,000 volts was received at the receiving plant of the Pennsylvania Water & Power Company, at Highlandtown, whence the energy will be distributed to Baltimore industries. Before the moment of introducing the current into Baltimore arrived the visitors inspected the plant and J. E. Aldred, president of the Pennsylvania Company, explained the work of constructing the buildings and dams and the installation of the machinery. The visitors were then escorted to a house on a hill a short distance away, where luncheon was served. Upon their return to Baltimore they visited the transformer house at Highlandtown. President Aldred, in a speech after the visitors had inspected the plant, said that while all of the investors expected to reap a profit from their investments, yet he believed that the introduction of this new power into Baltimore meant more for the Monumental City than it did for the moneyed men who were interested in the giant enterprise. He concluded his speech by saying that the profit referred to is that profit which comes from making two blades of grass grow where one grew before; that the company does not pretend to be made up of philanthropists or guardians of the people, its principles being plain and simple—to do business, and more of it, with a firm belief that the best way to bring this about is to give the consumer the best goods at the lowest possible price. The United Railways of Baltimore is also expected to contract for a portion of the McCall Ferry output, but as yet no such arrangements have been definitely made.

New York Commission News.

Commissioner Maltbie, of the Public Service Commission of the First District of New York, held a hearing last week on the complaints of consumers in the Far Rockaway section against the rates charged for gas and electricity by the Queens Borough Gas & Electric Company. The attorney representing the complainants was Mr. C. A. Brodek, while Mr. Eugene D. Hawkins represented the company. Two complaints were filed last spring, one concerning gas, the other electricity, each being signed by 100 consumers. An effort to reach a compromise with the consumers failed and the company was then given several months' time in which to go over its books and prepare a statement concerning the cost of manufacture and operation in order that the commission might have proper data upon which to base its decision as to reasonable rates. Mr. Carleton Macy, president and general manager of the company, testified that these statistics had been prepared in regard to gas, but that the investigation of the electrical accounts had not yet been commenced. Mr. Francis Blossom, of the firm of Sanderson & Porter, testified that his firm acted as operating engineers of the plant and that he had made a thorough examination of the operating cost of the gas plant, which he figured at 77 cents per 1000 cu. ft. The average annual consumption per meter is about 25,000 cu. ft. The hearing was adjourned until Oct. 19.

The practice of gas and electrical corporations in requiring deposits of consumers as security for the payment of bills is to be regulated by the Public Service Commission, Second District. A notice has gone out to all the companies of a hearing to be held in Albany on Nov. 1 at which will be discussed the rules and regulations proposed to be adopted.

The proposed order in its more important requirements provides that interest at the rate of 6 per cent per annum shall be allowed on all deposits and shall be paid annually; it provides the specific manner in which the companies shall keep a record of each deposit; it prescribes the form of receipt that shall be used, upon the reverse side of which is to be printed for the information of the consumer the terms and conditions upon which the deposit is exacted and may be withdrawn, and it requires each company not only to use these receipts hereafter, but to substitute them for the receipts now outstanding.

This action of the commission is the result of an extended investigation into the practice. The investigation disclosed that many of the companies allowed depositors less than the legal rate of interest and not a few paid no interest whatsoever upon deposits; that in many instances no explanation was made to consumers as to why security was demanded and no information given as to their rights; and that proper records of deposits were not kept. The purpose of the proposed order is to remedy these and other conditions and to put the methods of all the companies upon a uniform basis.

The right to exact deposits from consumers is given gas and electrical corporations in section 63 of the Transportation Corporation Law, and many of the companies avail themselves of the privilege in order to secure doubtful accounts. Outside of New York City upward of 50,000 consumers, in order to secure gas or electrical service, have been obliged to advance security varying in amounts from several dollars to several hundred dollars. The deposit funds in the possession of the companies now approximate half a million dollars.

The commission has received an application from the Hudson River & Eastern Traction Company for authority to issue $50,000 of additional common stock and $850,000 additional first-mortgage bonds. The company is now engaged in operating an electric railroad in the town of Ossining and intends to complete the construction of its line from its present terminus in the Camp Woods in the town of Ossining to the village of White Plains, a distance of approximately fourteen miles, exclusive of sidings. It is stated that this will require an expenditure of $621,000.

The commission has received a complaint from the Lycoming & New Haven Telephone Company against the New York Telephone Company. The former company owns and operates a telephone line from Lycoming, in the town of Scriba, to Dempster, in the town of New Haven, in the county of Oswego. The line in question is about six miles in length. It is alleged that the New York Telephone Company has neglected and refused to allow patrons and subscribers of the complainant's line to use the lines of the New York Telephone

Company through and beyond the switchboard of the complainant at Lycoming, although requested to do so. It is stated that the New York company refuses to grant the service unless the complainant company will pay to the New York Telephone Company the sum of $3 per subscriber in addition to the tolls exacted by the New York Telephone Company, and in addition demands that the complainant shall buy the stock of certain dissatisfied stockholders.

The Huntington Light & Power Company has been authorized to execute a mortgage for the sum of $250,000 and to issue bonds to the amount of $98,000 and additional capital stock to the amount of $2,000. The proceeds are to be used for the discharge of outstanding obligations to the amount of $86,000; the improvement of plan and distributing system, $14,000; and $42,000 to purchase the outstanding bonds of Huntington Gas Company at a price not to exceed 70.

Wisconsin Commission News.

In deciding the case of the Beloit Water, Gas & Electric Company vs. the City of Beloit the commission has issued an order which, while having an immediate bearing upon the water department of the utility, is of importance inasmuch as it represents the attitude of the commission toward extensions in all branches of the public utility service.

The petitioners allege that an ordinance of the City of Beloit ordering an extension of water mains is unreasonable, one reason being that the number of prospective consumers is not large enough to make such an extension reasonably remunerative. The commission held that, taking into consideration the expense of construction and the revenue to be derived from such an extension, the ordinance is not unreasonable; that a public utility cannot be required to make extensions indiscriminately, without reference to cost and revenues, but that a utility may well be expected to incur expense in order to serve citizens whom it cannot now serve if there is a reasonable prospect of an increase in revenues sufficient to warrant the expense.

The La Crosse Gas & Electric Company has petitioned the commission for authority to increase its rates. This is the second time the company has applied for an increase in rates, the first application resulting in the first rate decision issued by the commission and therefore being more or less of a tentative nature. The hearing before the commission in the case of the City of De Pere against the Green Bay Traction Company, involving the sale of six tickets for a quarter, has been indefinitely postponed, no date having been fixed.

The commission has authorized the Chippewa Valley Railway, Light & Power Company to issue $100,000 par value of first-mortgage, twenty-year gold bonds of the denomination of $1,000 each, bearing interest at the rate of 5 per cent per annum, to be issued in accordance with the terms of a deed of trust to the Harris Trust and Savings Bank and Andrew Cooke, of the City of Chicago, trustees. The bonds are to be issued and sold for the purpose of supplying the company with funds (a) to complete a concrete dam and power house now being constructed across the Red Cedar River, at Cedar Falls, Dunn County, Wis.; (b) to acquire certain additional riparian rights above the dam made necessary by the erection thereof and which are necessary for the use of said dam when completed; (c) to pay for additions to its property, including the transmission line from Eau Claire to Chippewa Falls; (d) to pay the floating indebtedness incurred by reason of extensions and additions to its property. These bonds are to be issued for money only and for not less than 75 per cent of the par value.

The commission has authorized the Milwaukee Western Electric Railway Company to issue stock and bonds as follows: (1) Ten thousand shares of common stock, of the par value of $100 each, being an issue of $1,000,000, said stock to be issued for money only and at not less than par value. (2) Two and one-half million dollars par value of first mortgage, 5 per cent gold bonds, of the tenor and under the conditions to be set forth in a certain mortgage or deed of trust to be hereafter executed by said company. The bonds are to be sold for money only and for not less than 75 per cent of the par value thereof.

The stock and bonds are to be issued and sold in order to supply the company with funds for the following purposes: (1) To pay for the construction of a line of electric railway extending from the City of Milwaukee to the village of Fox Lake, Dodge County, Wis., with a branch line running from the village of Sussex to the City of Waukesha, Waukesha County, Wis. (2) To pay for the equipment, including the building of power houses, transmission lines, depots, etc., the purchase of rolling stock, machinery of all kinds, right of way and real estate, and everything necessary to carry on the business of the company. (3) To purchase all property of any kind and any claim or right necessary for the purposes of the company.

Maryland Commission News.

The Maryland Public Service Commission last week announced its first important decision, when it dismissed the application of a number of residents of Ellicott City to compel the United Railways and Electric Company to reduce its fare from 15 cents to 10 cents one way from Baltimore to Ellicott City. The case has been under consideration for several months, during which time a number of hearings have been held. In their complaint the people of Ellicott City alleged that they were discriminated against by the fact that the company sold commutation tickets at reduced rates to residents along the Catonsville line. In concluding its decision the commission stated that any material reduction of the fare would jeopardize the interest on the bonds of the company, and, under the provisions of section 30 of the Public Service Commission law, it would require a clear case to warrant any action on the part of the commission that would tend to "disturb the value of any bonds of any of said corporations issued prior to the passage of this act." The decision states that the complainants themselves appear to consider the present charge reasonable and proper for all persons who are not residents of the section traversed by the Ellicott City line, and ask an order "compelling the said United Railways to correct said unjust discrimination and unjust charge on said line by issuing commutation tickets to residents of Ellicott City and intermediate points." The commission considers it altogether beyond its power to order one rate of fare for residents, when for precisely the same service at the same time, and under the same conditions, a higher rate is applied to the general public. That, it said, would be a gross form of the unjust discrimination which the law creating the commission expressly forbids. If it were true that it is the custom of the defendants to issue such "resident tickets" on other suburban lines, it might not be proper for the commission to order a discontinuance of such custom without giving the parties interested an opportunity to be heard in its defence, and the counsel of the body would be directed to take whatever steps might be necessary for that end.

Canadian Hydroelectric Commission News.

When the contract under which the Toronto Electric Light Company lights the Toronto city streets expires, on Dec. 31 next, the municipal power department will be ready to supply energy to 600 of the new street lamps in the residential district from the Niagara hydroelectric plant. There are 600 concrete poles now being erected on the streets at the rate of a mile of streets per day. In addition, five-light cluster lamps will be erected on the business streets downtown.

During the week Premier Sir James Whitney, who has returned from Europe, in speaking of the litigation going on between the city and the Toronto Electric Light Company over the erection of the former's poles on the streets, gave out an interview in which he hinted that unless the differences were adjusted the Ontario Legislature might take action. Subsequently the company wrote to Mayor Geary stating its will-

ingness to adopt the suggestions of the trial judge and the Premier looking toward a settlement, and further announced that the company would be willing to consider the purchase of its plant and equipment at the present time.

The London Electric Company is also reported as being about to make a new offer to the London City Corporation looking to the purchase of its plant by the municipality. The last offer was made by the company at $400,000 for the entire system, which offer was not accepted by the corporation.

CURRENT NEWS AND NOTES.

Calgary 19,500-hp Hydroelectric Plant.—During the coming winter the Calgary Power Company, Limited, will complete its 19,500-hp plant on the Bow River, 50 miles west of Calgary, where a head of 75 ft. has been developed. The transmission will be at 55,000 volts.

Columbia Electrical Society.—The first fall meeting of the Electrical Engineering Society of Columbia University will be held on Oct. 21, at which time Prof. F. B. Crocker will deliver an address on "Electrical Engineering in the Far East." The meeting, which will be open to the public, will begin at 8:15 p. m.

Sixty-six Thousand-hp Oregon Hydroelectric Plant.—The Mount Hood Railway & Power Company, of Portland, Ore., will complete rapidly the first of its three hydroelectric plants aggregating 64,000 hp. The initial plant will supply 16,000 hp and commence delivery of electrical energy to Portland by August of next year.

Special Pittsfield-Schenectady Meeting of the A. I. E. E.—Arrangements are being made for holding a joint meeting of the Pittsfield and Schenectady sections of the American Institute of Electrical Engineers during February, 1911. The meeting will be of the same general character as those held at Charlotte, N. C., and San Francisco, Cal., last spring.

Steel for Boilers.—At the recent Chicago convention of the American Boiler Manufacturers' Association a change was noted in the "Uniform American Boiler Specifications" by which it is recommended that the content of sulphur in flange or boiler steel be not over 0.03 per cent instead of 0.04 per cent, and that the content of phosphorus be not over 0.04 per cent instead of 0.06 per cent.

Electrical Communication and Signaling on Illinois Central.—An interesting item in the annual report of the Illinois Central Railroad Company for the year ended June 30, 1910, shows that the expense of operating the telegraphs and signals of the company for that year was $275,492.43. During the year the value of additions and betterments made to telegraph and telephone lines on this railroad system amounted to $16,092.11. The system operated by the Illinois Central comprises 4550 miles of railroad.

A. I. E. E. Boston Meetings.—During the present society year there will be three joint meetings in Boston of the Boston Section of the American Institute of Electrical Engineers, American Society of Mechanical Engineers and the Boston Society of Civil Engineers, and in January there will be a joint dinner of the three societies. In addition there will be eight regular and three special meetings of the A. I. E. E. section, the latter to be held respectively at Harvard, Tufts and the Massachusetts Institute of Technology. Mr. Harry M. Hope, 147 Milk Street, is secretary of the section.

Pennsylvania Electric Trains Under the Hudson.—According to the latest official announcement, the Pennsylvania Railroad's Hudson River tubes will be opened for traffic on Nov. 27, which is the first day of the fall train schedule. The new section extends from the station at Seventh Avenue and Thirty-third Street to Harrison, N. J., where it meets the old main line. The tunnels between the New York station and Queens have been in operation since Sept. 8. When the Harrison extension is opened, the entire electrical installation, except the New Haven railroad connection, will be in operation.

Gifts to the University of Illinois.—The General Electric Company has presented to the University of Illinois a recording steam meter, a device used as a means of determining the quantity of steam passing any pipe to which it may be attached. The gift was transmitted on behalf of the company by its sales manager, Mr. F. G. Vaughen, to Prof. Ernst J. Berg, in charge of the department of electrical engineering. This is the second significant gift that the General Electric Company has made the University of Illinois within a year, the first consisting of a 100-kw Curtis steam turbo-generator, which now constitutes a part of the equipment of the department of electrical engineering.

Fuel from Peat.—The results of a further examination into the peat resources of Canada, and particularly Ontario, made during the season 1909-1910 are contained in a report just issued by the mines branch of the Department of Mines at Ottawa. The bogs examined, their situation and extent are as follows: Brunner bog, 8 miles west of Stratford, 2288 acres; Komoka bog, 12 miles from London, 900 acres; Brockville bog, 3 miles from Brockville, 1400 acres; Rondeau bog, on shore of Lake Erie, 6 miles from Blenheim, 1571 acres. All these bogs can be worked at a profit, according to the report. A separate report is also made on the government peat bog at Alfred, while the plants at Dorchester and Farnham, Province of Quebec, are referred to favorably. Dr. Eugene Haanel is Superintendent of Mines at Ottawa, as well as being president of the Canadian Peat Society.

Los Angeles License Tax Valid.—The city license ordinance of Los Angeles, Cal., adopted by referendum vote of June 30, has been declared valid, in so far as the provisions relate to the taxes upon gas and electric corporations according to an opinion recently handed down by Judge Conroy, of the Supreme Court. The Los Angeles Gas & Electric Corporation and the Southern California Edison Company attacked the ordinance as void, and asked permanent injunctions to prevent the enforcement of its provisions. Judge Conroy denied the injunctions asked. The court disposes of the objections to the reasonableness and definiteness of the ordinance by declaring the provisions are not uncertain. Several banks which originally joined in the fight against the ordinance withdrew their objections several weeks ago. The tax against which the lighting companies fought was one-third of 1 per cent on the gross receipts for the sale of electricity and gas, the tax to be payable quarterly.

Proposed Railroad Terminal Electrification in Chicago.—No active steps are being taken toward the desired electrification of steam-railroad terminals in Chicago, but the newspapers keep up the fight energetically. In a recent editorial the Chicago *Daily News* remarked: "Of course, the opinion of engineering and financial experts must to a large degree control in matters of this kind. But these experts should be employed, in part, at least, by the public authorities to make disinterested reports. The railroads should not be allowed to decide by themselves that the cost is prohibitive." The Chicago *Daily Tribune*, after stating that as soon as details can be agreed upon with the authorities of New York City, the entire freight line of the New York Central on the west side of Manhattan Island is to be electrified, points out that the managers of that railroad have resolved to do something which the Chicago roads say would involve intolerable expense and constant danger. The *Tribune* calls again for a railroad-electrification commission for Chicago.

Denver City Lighting.—Denver has 2317 arc and 842 50-cp lamps in use on the streets and boulevards. In addition there are 132 arcs in the parks and more than 100 50-cp incandescents. The Welcome Arch contains 1294 4-cp lamps and costs $75 per month to maintain. The total cost of city lighting, exclusive of parks, was $13,499.41 for the month of September.

Proposed Electric Club in Cedar Rapids.—Electrical men in Cedar Rapids, Ia., are discussing the possibility of organizing an electric club. It is believed that a membership of from fifty to sixty could be secured, and the idea is being received with favor. Mr. J. C. Young, superintendent of the lighting department of the Cedar Rapids & Iowa City Railway & Light Company, and Mr. E. H. Ball, of E. H. Ball & Company, electrical contractors, have shown particular interest in the project.

Oil Fuel.—Tests recently made at the Las Cascadas air-compressor plant, Panama Canal Zone, on California crude oil burned under boilers gave an equivalent evaporation of 14.40 lb. of water from and at 212 deg. Fahr. per pound of oil, and 14.63 lb. of water per pound of combustible. The tests were made on six return fire-tube boilers, there being two trials of seven and one-half and nine hours, respectively. A similar test was made at the Mount Hope pumping station on a locomotive-type boiler, which gave 13.11 lb. of water from and at 212 deg. Fahr. per pound of oil, and 13.40 lb. per pound of combustible.

Railroad Electrification and Switching Operations.—In discussing Mr. B. E. Sunny's paper on "The Engineering of Chicago" at a recent meeting of the Western Society of Engineers, Mr. W. E. Symons said that undoubtedly the electrification of steam-railroad terminals will be adopted in all large cities at some time in the future. Probably the system of establishing an electric zone will be employed. Such electrification is not out of the experimental stage as yet, declared Mr. Symons, so far as it is applied to switching operations on a large scale, although it is quite satisfactory for the operation of made-up trains.

Boiler Supplymen's Association.—During the annual convention of the American Boiler Manufacturers' Association in Chicago, on Oct. 13, the allied Supplymen's Association held its annual meeting also. The business transacted was not of general interest, except the election of these officers: President, Mr. W. O. Duntley, Chicago; vice-president, Mr. J. T. Corbett, Chicago; secretary, W. H. S. Bateman, Philadelphia; treasurer, H. B. Hare, Cleveland; executive committee, D. J. Champion, of Cleveland; Thomas Aldcorn, of New York; F. B. Slocum, of New York; C. M. Chamberlain, of Chicago, and R. S. Groves, of Philadelphia.

Pittsburgh A. I. E. E. Meeting.—The October meeting of the Pittsburgh section of the American Institute of Electrical Engineers was devoted to a discussion of the New York paper of Messrs. Stott and Pigott on a "15,000 kw Steam-Engine-Turbine Plant." Among the points brought out is the improvement of economy by adding a low-pressure turbine to a condensing engine, it being generally thought that the place for the low-pressure turbine is as an addition to a non-condensing plant. Messrs. E. D. Dreyfus and W. B. Flanders, of the Westinghouse Machine Company, called attention to the comparatively low efficiency of a turbine in per cent of Rankine cycle efficiency as compared to the efficiency of the high-pressure reciprocating unit. It was shown that there is considerable room for improvement, and it was stated that there is a probability of such improvement. Messrs. W. L. Waters and F. W. Harris, of the Westinghouse Electric & Manufacturing Company, discussed the electrical phase of the situation. It was shown how the induction generator is especially adapted for use in this type of plant, due to the large charging current of the underground cables, and especially desirable in so large a plant on account of the low short-circuit current of these machines. It was stated that oil switches of the present type are capable of opening very heavy short-circuits, but, in case of very heavy plant capacity, at the cost of the destruction of the switch. It was stated that switches of a new type will be available in the very near future, such that the allowable plant capacity will not be limited by the oil switches.

New York I. E. S. Section.—At the October meeting of the New York section of the Illuminating Engineering Society Mr. W. H. Gardiner was elected manager to succeed Mr. S. G. Rhodes, who resigned during the summer. Papers were presented by Messrs. P. S. Millar, H. S. Whiting and A. J. Marshall. Abstracts of these papers and the discussions are given elsewhere in this issue. At the November meeting papers on theoretical and practical subjects will be presented by Prof. E. L. Nichols and Mr. Bassett Jones, Jr.

Wireless on African Lines.—According to Vice-Consul Alexander W. Weddell, at Zanzibar, the Deutsche Ost Afrika Linie, with headquarters in Hamburg, whose ships, in connection with those of the Woermann Line, encircle the African continent, is installing a wireless telegraph system on its nine main-line vessels; a tenth boat, now under construction, and which will be finished by the end of the year, will be similarly equipped. The Telefunken system is used; wave length, 600 meters, but wave lengths of 300 and 400 meters can be also used; radius, 250 miles (though communication has been established at 370 miles); power, 2½ kw; code, Morse. Messages for these vessels are accepted by the Zanzibar government offices at Zanzibar and Pemba, the range of which is about 200 miles; the charge is 2 annas (4 cents) per word, with a minimum charge of 1 rupee (32 1/3 cents) per message.

Nickel-in-the-Slot Street Lighting.—Basing its suggestion on an editorial in the *Electrical World* of Sept. 29 on "Street Lighting Economy," which it quotes in full, the Albert Lea (Minn.) *Evening Tribune* suggests, apparently in a sarcastic vein, that the idea of a slot machine for public lighting might be adopted in that city. "With such a contrivance," says the *Tribune*, "the patriotic citizen who is entertaining a visitor on a moonlight night might bring him down town, drop a quarter in the slot, put the light on for a minute or two and 'show' him rather than tell him what a beautiful and modern lighting system we have. If the city cannot afford to light the streets every night, why not let the citizens help out a bit?" The point of the satire is that Albert Lea has a fine modern electric lighting system and that it is false economy to fail to use it when the moon is shining, or, worse still, when it is supposed to shine but does not penetrate the clouds.

Kansas City an Electrical Pioneer.—In a paper presented before the recent meeting of the Kansas Gas, Water, Electric Light and Street Railway Association, Mr. Edwin R. Weeks, past-president of the National Electric Light Association, stated that in Kansas City was established the first central station using the Thomson-Houston system of electric lighting, and also one of the first stations employing the Edison system. In Kansas City was also established one of the first, if not the very first, commercial electric street railway using the overhead trolley. The rolling stock consisted of two cars, each equipped with a 7½-hp, 250-volt, direct-current motor. There were two overhead trolley wires 10 in. apart, and two pairs of trolley wheels held by springs in lateral contact with each wire, the trolley wheels being all mounted on a single carriage and connected with the motors by flexible duplex cables. Mr. Weeks said that he served as court appraiser some twenty odd years ago on the remains of this road, which paid its creditors 8 cents on the dollar.

OIL AND GAS FUEL STATION AT WICHITA, KAN

A Modern Generating Plant Especially Noteworthy for Compactness and Economy of Operation.

IN Wichita, Kan., the Kansas Gas & Electric Company is engaged in the erection of a new generating station that has a number of interesting features. The station is being built for an output of 8750 kw, and it will be a gas-burning or oil-burning station, although the design is such that additions permitting the burning of coal as fuel can be made readily. The plant will be run condensing, using the water of the Arkansas River for that purpose. Its output will be used for commercial lighting and motor service, electric railway service and street lighting. The plant is designed especially with the idea of reducing the cost of operation to the minimum.

As shown in Fig. 1, which is a map of the site of the new station, the building fronts on Third Street, and is near the

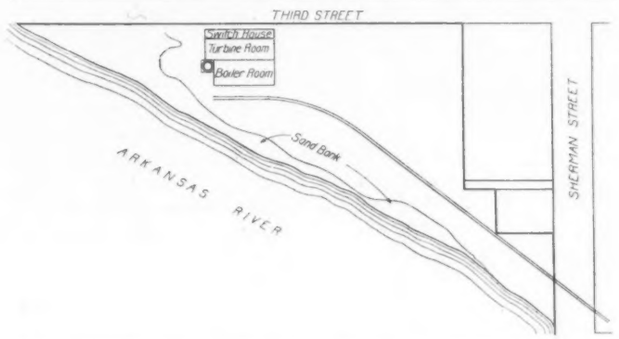


Fig. 1—Map of Site of New Station.

Arkansas River at the point where the Little Arkansas flows into it. The site is triangular in shape, the property fronting about 850 ft. on Third Street and about 1200 ft. on the river. The building itself is 135 ft. wide on Third Street and about 110 ft. deep. It consists essentially of three parts—a boiler-room, a steam turbine-room and a switch house. The last-named consists of three stories, as shown in Fig. 2, which is a general cross-section of the power house. The general arrangement plan, Fig. 3, shows the layout. The building is of steel skeleton construction with brick walls.

BOILER-ROOM EQUIPMENT.

In the boiler-room, as shown in Fig. 3, four boilers will be installed with room for two more. Each of these boilers will be of the Babcock & Wilcox type and have 5680 sq. ft. of heating surface. The boiler-room is over 30 ft. high, and beneath it is a 12-ft. basement. The level of this basement floor is the same as that of the floor of the turbine-room and switch house. There are large openings in the wall between the turbine-room and the boiler-room, so that for operating purposes there is practically only one room. The boiler furnaces are equipped with both oil burners and gas burners. As shown in Fig. 2, they have a very large combustion chamber and are of unusual size. They are fired from under the rear of the boiler on the side facing the turbine-room, so that the turbine-room attendant may also care for the boilers, if necessary. The arrangement is such that there is practically one central operating space for both the turbine-room and the boiler-room, all operating parts being near at hand and very accessible.

There will be a steel stack 14 ft. in diameter and 199 ft. 6 in. in height above the boiler-room floor. The breeching is placed in the base of the stack in such a manner that it would not be necessary to disturb it in case the station is later equipped for burning coal. As will be noticed in Figs. 2 and 3, there is ample room to install automatic stokers, should they be desired later, while the structure and roof of the boiler-room are designed with special reference to supporting coal and ash-handling machinery if desirable later on.

GENERATING UNITS.

In the turbine-room there are three main generating units and the steam piping is so arranged as to be particularly compact and so as not to interfere with the future installation of coal-burning and coal-handling apparatus. Indeed, the changes necessary for the use of coal as fuel could be made without seriously interfering with the operation of the station. The piping layout is also unusual. The arrangement is such that three boilers are drawn upon to supply steam to a main header, which is run directly to each of the 4000-kw steam turbines. There are two of these main headers, and they are cross-connected with a loop which also serves as an auxiliary header for supplying steam to pumps and condensers. The 750-kw turbine is supplied with steam from the header leading to the 4000-kw unit adjacent to it.

Three turbo-generators will be installed in the turbine-room. The one shown at the right in Fig. 3—that is, at the eastern end of the turbine-room—is a 4000-kw horizontal Curtis turbine turning at 1800 r.p.m., the electrical end of the unit being a General Electric alternator. To the west of this, with centrifugal pumps and various steam auxiliaries between, is another 4000-kw unit. This also consists of a horizontal Curtis turbine and a General Electric alternator, but in this case the speed is 1200 r.p.m. These two machines are new. In the western end of the room is a 750-kw vertical unit from the same manufacturer. This, however is an older machine which will be taken from the existing station of the Kansas Gas & Electric Company. All of the generators are wound for three-phase alternating current at 2300 volts and 60 cycles.

CONDENSERS AND AUXILIARIES.

There is a separate surface condenser for each generating unit. These condensers have 11,000 sq. ft. of area in the case

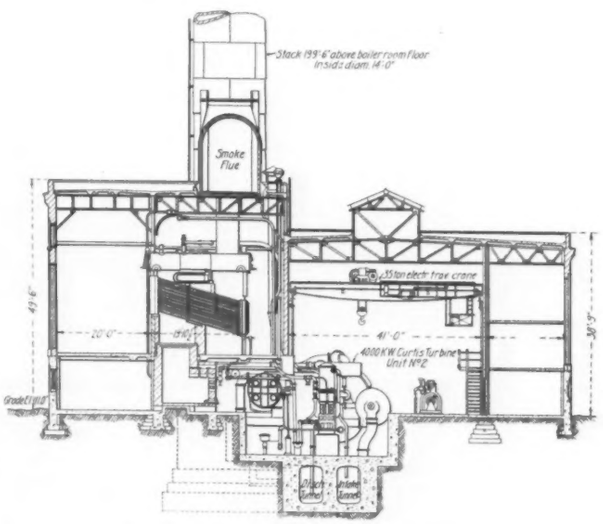


Fig. 2—Cross-Section of Power House.

of the 4000-kw units and 3000 sq. ft. for the 750-kw unit. A combined circulating and dry-vacuum pump is provided for each of the 4000-kw units. This is driven by a steam engine, the circulating pump having a rating of 11,000 gal. a minute. For the smaller generating unit there is a motor-driven circulating pump rated at 3000 gal. a minute. For this generating unit an independent steam-driven dry-vacuum pump is provided. There is an independent hot-well pump, steam-driven, for each unit. A group, consisting of one feed-water heater and two vertical steam boiler-feed pumps, centrally located, as shown in Fig. 3, supplies feed water for the whole station. A 35-ton electric overhead traveling crane spans the turbine-room.

Water for condensation is obtained from an intake crib located about 330 ft. west of the station at the junction of the Little Arkansas and Arkansas Rivers. This point was selected because the water of the Little Arkansas River is much purer

than that of the larger stream. From the intake crib an intake tunnel 5 ft. in diameter leads to a well just outside the building. From this point, as shown in Fig. 2, the intake tunnel, which is 5 ft. wide and 8 ft. high, is rectangular in section. The discharge tunnel is of the same dimensions as the intake tunnel, but turns almost directly south after leaving the building and empties into the Arkansas River at the nearest point, being about 105 ft. long. These two tunnels are placed side by side under the turbine-room, as shown in Fig. 2. The circulating pumps are placed on the intake tunnel side of the room, and the condensers are so arranged on the other side that the discharge from them passes to the discharge tunnel with the minimum amount of large piping. The arrangement is notably compact; the condensers, as shown in Fig. 2, are placed in a rather unusual position right back of the boilers to save space.

THE OUTPUT OF THE STATION.

The electrical equipment in the turbine-room, in addition to the three generating units already mentioned, consists of four 500-kw motor generators and two 100-kw exciters, placed as indicated in Fig. 3. The four motor generators consist of 700-kw synchronous motors driving 500-kw generators, the latter designed with liberal allowance for overload. Two of these sets provide 275-550-volt direct current for the three-wire system and two provide 550-volt direct current for railway purposes. The arrangement is such that the three-wire machines can be operated on either the three-wire busbars or the railway busbars.

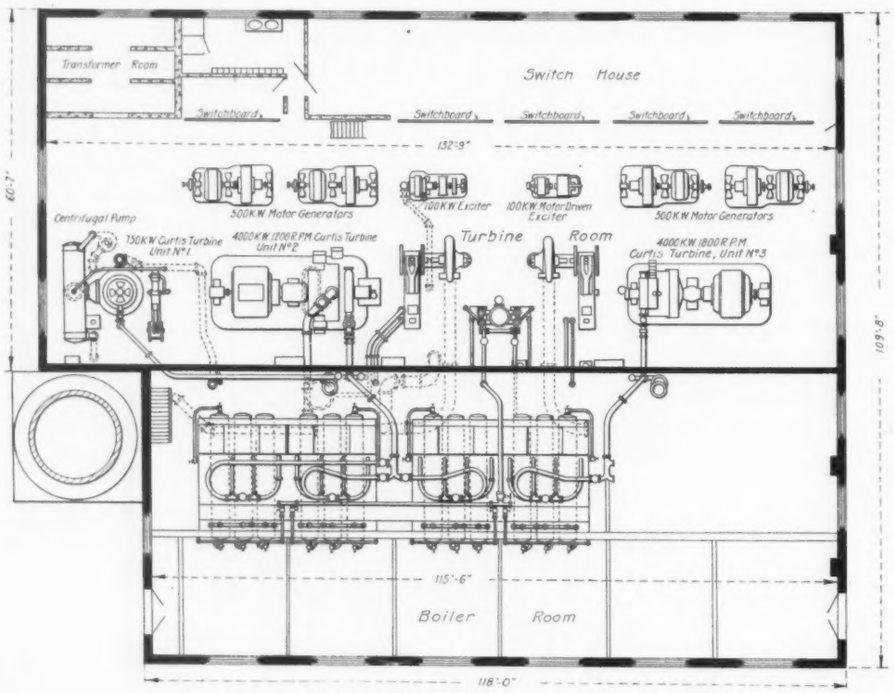


Fig. 3—Layout of Station.

As stated, the alternating-current output of the station is generated at 2300 volts. Nine outgoing feeders are used for commercial lighting and motor service and are supplied with alternating current at the machine voltage. In addition, provision is made for a 34,000-volt (or possibly 60,000-volt) transmission line to be supplied with energy from this station through step-up transformers located in the building. This transmission line will deliver energy to substations, which will convert the high-tension 60-cycle electrical energy by step-down transformers and motor-generator sets into direct current for the operation of an interurban electric railway. Alternating current is also supplied for eight series arc circuits, each designed for seventy-five lamps used for street lighting in Wichita. Four of these circuits are equipped with enclosed arc lamps, and four are equipped with magnetite arc lamps.

The direct-current load is carried by two 275-550 three-wire feeders for motors and ten 550-volt railway feeders. By means of the latter electrical energy is transmitted directly to the system of the local electric railway company, the total consumption being measured in the station. Provision is made so that all feeders, except the 34,000-volt transmission line, may be taken out of the station either overhead or underground.

GENERAL ARRANGEMENT OF SWITCHING EQUIPMENT.

In all there will be twenty-one motor-operated oil switches ranging from 300 amp to 800 amp in rating for the control of the turbo-generators and the synchronous motors of the motor-generator sets, one being reserved for the control of the smaller motors and auxiliary apparatus in the station. Starting switches for synchronous and induction motors are of the solenoid-operated type, and are mounted on pipe framework. The motor-operated and solenoid-operated oil switches are electrically interlocked, insuring proper sequence of operation when starting up motors. The motor-operated oil switches are located on the first gallery floor of the switch house, and are placed in fireproof cells. The solenoid-operated switches are placed on the main floor of the switch house, back of the switchboards, which are on the dividing line between the turbine-room and the switch house.

Busbar Chamber.—Both main buses and auxiliary and starting buses are supported on porcelain insulators, which in turn are mounted on pipe framework. The latter will be erected on the switch-house floor back of the switchboards. On account of the comparatively low e.m.f., 2300 volts, no fireproof busbar structure has been found necessary.

All disconnecting switches, shunt and series instrument transformers will also be installed on suitable pipe framework on the switch-house floor in the busbar chamber.

Second Gallery Equipment in Switch House.—The floor space in the second gallery of the switch house (Fig. 2) is devoted to the feeder regulators used to keep the potential constant on those feeders which supply lighting service exclusively. In addition, there will be installed in this gallery, on the floor and walls, a pipe framework supporting the disconnecting switches for the outgoing feeders.

The lightning arrester equipment for the 2300-volt feeders is also to be placed in this gallery, while the lightning arrester equipment for the 34,000-volt line, together with the high potential circuit breakers, is to be installed in a fireproof compartment in the transformer room, the latter being in the northwestern corner of the building, as shown in Fig. 3.

EXCITATION.

There are provided for the excitation of the generators and synchronous motors a 100-kw generator driven by a steam turbine and another unit of similar size driven by an induction motor. Each synchronous motor of the motor-generator set has been provided with an individual exciter, the armature of which is keyed to the main shaft.

The plan of excitation is as follows: Under normal operating conditions the motor-driven exciter provides for the turbo-generators and the individual exciters provide for the excitation of their respective synchronous motors in the motor-generator sets. The 100-kw turbine-driven exciter is used as reserve. Two sets of excitation buses have been provided, the

arrangement being such that either the steam-driven exciter or the motor-driven exciter may supply any pair of these buses. In case of the breakdown of an exciter supplying electricity for the synchronous motors the latter may be excited from the second set of excitation buses mentioned above.

SWITCHBOARDS.

There are to be six switchboards in all in this power house. The location of five of these boards is shown on Fig. 3. As indicated, they are on the dividing line between the turbine-room and the switch house, each occupying the space between building columns supporting the wall separating these two divisions of the power house. Beginning at the eastern side of the building, as indicated in Fig. 3, the switchboards in order are: No. 1, controlling generators and exciters; No. 2, three-phase feeders; No. 3, motor-generators and three-wire feeders; No. 4, railway feeders; No. 5, station lighting and motor apparatus; No. 6, arc circuits.

The switchboards are made with blue Vermont marble panels on pipe framework, and one interesting feature is the arrangement used to distinguish the various classes of instruments. All voltmeters are nickel-finished, all polyphase indicating wattmeters have oxidized copper finish, and all other instruments are dull black. Thus the eye of the attendant will be at once arrested by the particular kind of instrument which he is seeking to consult. This is another of the labor-saving ideas emphasized in the design of this station.

STATION LIGHTING AND MOTOR LOAD.

The lighting of the station building itself includes arc lamps in the turbine-room and boiler-room for general illumination and incandescent lamps for specific or local illumination. The arcs will be of the intensified type, operated on 110-volt, 60-cycle, alternating-current circuits. The incandescent lamps will be normally operated on 110-volt, alternating-current circuits, provision being made to operate them, in case of emergency, from the excitation buses. In case both the excitation circuits and the 110-volt alternating-current circuits should fail, a double-pole switch on the distribution panel of the station lighting switchboard is closed, and about fifty emergency lamps will be thrown in circuit with a storage battery. These emergency lamps are placed with a view to having light in the more important parts of the station in case the normal source of lighting should fail.

The incandescent lighting circuits in the station have been arranged so that three-lamp incandescent clusters, located on building columns, will be controlled directly from cut-out cabinets, of which there are three—two in the turbine-room and one in the boiler-room. Where it was found necessary the shorter circuits have been provided with three-way switches, with a view of obtaining control from two different points.

The station motor equipment includes the supplying of electrical energy for operating the turbine-room crane, the circulating pump for the 750-kw generating unit, and two centrifugal bilge pumps located in the basement. The crane motors are three in number and are supplied with 500-volt direct current from the three-wire bus. The circulating pump motor is a three-phase induction machine operated at 2300 volts and 60 cycles. The centrifugal pump motors are single-phase repulsion-induction machines, to be supplied with 60-cycle energy at 220 volts. Provision has also been made to run cables for the motors of a future coal-handling equipment using 500 volts direct current.

STORAGE BATTERY.

A storage battery, to have a rating of 80 amp at the one-hour rate, is to be installed in the first gallery floor of the switch house, where an acid-proof compartment will be provided. The primary purpose of this battery is to supply the motor-operated and solenoid-operated switches with direct current at 110 volts. In addition, the storage battery will be connected to the emergency lighting system as previously stated. The battery is charged from the three-wire buses, the so-called "bleeder system" being installed, so that the charging is practically automatically accomplished.

MISCELLANEOUS.

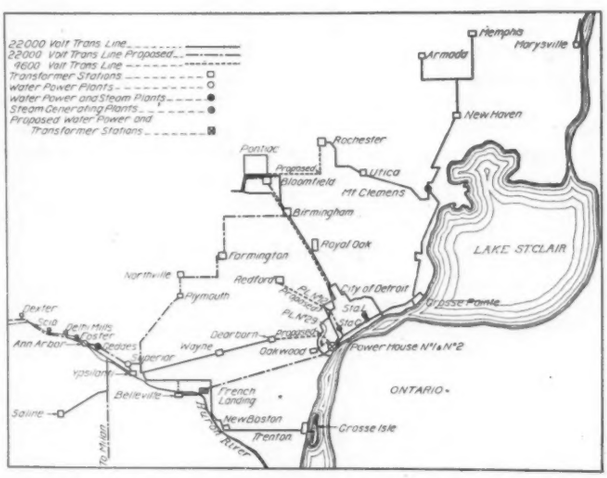
All rheostats for the main generators will be electrically controlled. The rheostats for the synchronous motors of the motor-generator sets are to be of the combination type, chain-operated, the rheostat for the synchronous motor and the motor exciter to be designed as one unit. The rheostats for the railway generators are to be chain-operated also. All rheostats, whether operated electrically or chain-operated, will be placed on pipe framework on the first gallery floor of the switch house.

There will be a system of signals to enable the switchboard attendant and the turbine-room engineer to exchange signals in relation to starting machines, the division of load, etc.

This interesting station was designed by Sargent & Lundy, engineers, Chicago.

INTERCONNECTED HYDROELECTRIC TRANSMISSION SYSTEM IN EASTERN MICHIGAN.

The suburban territory centering about Detroit, Mich., within a radius of fifty miles, is served with electrical energy by the Eastern Michigan Edison Company, whose interests are identified with those of the Edison Illuminating Company of Detroit. The Eastern Michigan Company operates several small low-head water-power generating stations on the Huron River, in the vicinity of Ann Arbor, supplementing the output from these stations with that from steam plants at Geddes and Mount Clemens, and from the Delray stations of the Detroit Edison Company. The stations just enumerated and the various communities served by the Eastern Michigan Company



Map of Hydroelectric Transmission System in Eastern Michigan.

are tied together by 22,000-volt transmission lines, as shown by the accompanying map of the system. This 22,000-volt system is at present chiefly radial from the important centers, but plans have been made for connecting together the outer extremities of these transmission lines, creating a network over which any point on the system can be reached from one of several lines.

The operation of the Eastern Michigan Edison Company is divided into the St. Clair, Washtenaw and Oakland divisions. The St. Clair Division serves the towns of Mount Clemens, Amada, New Haven, Memphis, and Marysville, aggregating 9300 inhabitants, among whom it has 1200 customers. The Washtenaw Division territory comprises Ann Arbor, Ypsilanti, Saline, Wayne, Trenton, Dearborn, Farmington and Northville. Ann Arbor has a population of 14,600, and Ypsilanti is about half this size. Wayne, Trenton and Northville are towns of about 1000 population. The total population served by the Washtenaw Division is about 28,000, out of which the company has over 3000 consumers. In the Oakland territory are Birmingham, Bloomfield Hills, Pontiac, Rochester, Royal Oak and

Utica, with an aggregate population of 27,000 and 600 electrical consumers. The Eastern Michigan Edison Company thus serves a total population of 64,000 and has nearly 5000 customers.

The Mount Clemens steam-driven generating station of the St. Clair Division contains 550 kw in alternating-current generating equipment, which supplies energy to a total connected load of 1575 hp.

The Geddes station of the Washtenaw Division is a combination plant, containing 780 kw in steam-driven and 400 kw in waterwheel-driven alternators. The Superior hydroelectric station (described on page 61 of the *Electrical World*, Sept. 15, 1910) contains a 450-kw alternator, and the Argo plant has a 200-kw waterwheel-driven machine. Thus, of the 1800 kw available capacity of the three plants of the Washtenaw Division, more than 1000 kw is water-power. The total connected load of this division is nearly 4000 kw. Of the average monthly output of the Oakland Division, 50,000 kw-hours, the largest part is supplied for electric railway purposes. The average monthly output of the St. Clair Division is 90,000 kw-hours, and of the Washtenaw Division 320,000 kw-hours.

The officers of the Eastern Michigan Edison Company are: President, Hoyt Post; vice-president, Alex. Dow; secretary, J. V. Oxtoby, and treasurer, K. A. McIntyre. Mr. E. F. Phillips, of Detroit, is general manager; Mr. R. W. Hemphill, of Ann Arbor, is manager of the Washtenaw Division, and Mr. J. C. Hoetger, of Mount Clemens, is superintendent of the St. Clair Division.

COST OF WATER-POWER AND COAL.

By Alton D. Adams.

GREAT hydroelectric systems are not here considered, but only moderate water-powers such as are often used with steam plants to operate central stations. Such water-powers are fairly represented by the figures for the eight plants given below, which are all located in the East. In rated capacities of water-wheels these plants vary from 339 hp to 3175 hp, and at five of the plants the wheel capacity is above 1000 hp. The falls or normal operating heads of water on the wheels run from 10 ft. to 37 ft. and at five plants the heads are 20 ft. and less. Five plants pay a rental for the use of water, and three own the water-power. Only a part of the flow of the river can be used by the electric plants in three instances, and the total discharge of water is available at each of the others. In no case was the water sufficient to develop all of the required electrical energy, and so both the pounds of coal burned and the number of kw-hours generated are given for each plant.

The figures represent the operations of one year and are arranged in the order of the wheel-powers. At the smallest of the eight stations the wheel capacity was 339 hp, and the annual rental, with the land required for the development, the dam and a station building, was $2,500, or $7.37 per rated horse-power of wheel capacity. The river structures were provided by the lessor; but the electric company furnished the wheels. The lease covered the flow of the river with a fall of 10 ft. and a probable minimum of less than 200 cu. ft. of water per second, so that the annual rental amounted to $250 per foot of fall.

OPERATIONS OF HYDROELECTRIC PLANTS.

H. P. of Wheels	Head of Water in Feet	Kw-Hours Generated During Year with Water and Steam	Coal Burned in Pounds
339	10		
384	16	273,725	304,640
735	16.6	2,448,207	8,099,840
1,120	20	6,127,660	17,674,269
1,200	37	2,948,150	1,153,600
About 1,560	14		
2,835	36	16,583,186	27,552,000
3,175	28	4,312,122	8,365,814

With the wheel capacity of 384 hp the electric company had the entire flow of a small river, and the output was largely devoted to lighting. The average load at this hydroelectric plant was only 41.6 electrical hp during the 8760 hours of the year, and the small ratio of this average to the wheel capacity probably accounts for the fact that only 1.1 lb. of coal were burned per kw-hour generated by water-power and steam-power combined.

An electric company that owned a water-power with the total flow of a river had wheels of 735 hp, and delivered the greater part of its output for electric traction besides supplying a lighting load. The average load at the generating station during the year was 372 electrical hp, which was developed in large part by steam as shown by the consumption of 3.3 lb. of coal per kw-hour.

The hydroelectric plant that had wheels of 1120 rated horse-power on a 20-ft. fall paid a rental of $13,790.40, amounting to $12.31 per horse-power for the water delivered from a canal to its wheels, and the supply was under the control of the water-power company. Besides this water-power the electric plant consumed more than 17,000,000 lb. of coal, amounting to 2.8 lb. per kw-hour generated by both steam and water. This plant sold fully 50 per cent more energy for stationary motors than for all forms of lighting combined, and its average load during all the hours of the year was 932 electrical hp. The rental for the water-power in this instance amounted to $689 per foot of fall, and to 0.22 cent per kw-hour generated by steam and water-power combined. To this must be added the cost of the 2.8 lb. of coal to obtain the average expense of water-power and fuel per kw-hour generated.

Water wheels of 1200 rated horse-power capacity were used on a 37-ft. fall with the entire flow of a small river by a hydroelectric system that had an average load on both steam-driven and water-driven generators of 448 electrical hp. Besides this, energy purchased from a much larger water-power represented an average load of 250 kw, so that the average on the system was 698 kw for the year. More than five times as much energy was sold for motors and traction purposes as for lighting. Under these conditions the coal burned amounted to only 0.39 lb. per kw-hour generated by both water-power and steam-power. It is probable in this instance that the purchase of energy from the large water-power plant kept down the average amount of coal burned per kw-hour generated.

For the two water-powers with wheel capacities of 2835 and about 1565 hp respectively a hydroelectric system paid an annual rental of $34,600 total, or $7.85 per rated horse-power of the wheels. These two water-powers are on the same river only a few miles apart and their combined head is 50 ft., so that the total annual rental amounts to $692 per foot of fall in the river. At one of the plants the electric company installed the wheels and generators and took water from a canal, and at the other plant the water-power company installed the complete equipment and delivered the output to the lines of the electric company. On the basis of its entire output from both steam-power and water-power the above rental paid by the electric company amounted to 0.21 cent per kw-hour generated, and on the same basis the coal burned was 1.6 lb. Though this electric system had a large motor load, its energy output for lighting was a little more than double the amount for motors, and the total average load on both the steam-power and water-power stations was 2524 electrical hp during the year, or about three-fifths of the water-wheel capacity.

The largest hydroelectric plant here considered had a water-wheel capacity of 3175 hp, and paid $19,779.69 as the annual rental of the water from a canal to operate these wheels under the head of 28 ft. Per horse-power of wheel capacity this rental is $6.23, and per foot of fall it is $706 for the water. In this instance the electric company installed the wheels and generators. The connected load of lamps was greater than that of motors, and the average load of the steam-driven and water-driven generators was 656 electrical hp for the entire year. On the basis of the total generated output from both

steam-power and water-power the rental of the water-power amounted to 0.46 cent per kw-hour, and the coal burned was 1.9 lb. per kw-hour on the same basis. This electric company used the water-power in common with a number of manufacturing plants.

ANALYSIS OF OPERATIONS.

H. P. Water Wheels	Rental Annually per Wheel H.P. Dollars	Rental Annually per Foot of Fall. Dollars	Rental per Kw-Hour Generated. Cents	Lbs. Coal per Kw-Hour Generated	Cts. Coal and Water Power Rental
339	7.37	250.			
384				1.1	
735				3.3	
1,120	12.31	689.	0.22	2.8	0.78
1,200				0.39	
Ab't 1,560	7.85	692.	0.21	1.6	0.53
2,835					
3,175	6.23	706.	0.46	1.9	0.84

Comparing the results of the above analysis, three of the four rentals show fairly close agreement per horse-power and three show very close agreement per foot of fall. In cost per kw-hour generated with both steam-power and water-power one of the rentals is more than double either of the other two, due in part at least to the low average load. The pounds of coal burned per kw-hour generated vary from 0.39 to 3.3, depending in part on the relative use of water-power. Assuming the cost of soft coal at $4.48 per long ton, or 0.2 cent per pound, the approximate price at the above plants, the combined cost of coal-power and water-power per kw-hour is obtained for three of the plants that rented water. Where 2.8 lb. of coal were burned per kw-hour generated the combined cost of coal and water amounts to 0.78 cent, and where 1.6 lb. of coal were burned the combined cost was 0.53 cent per kw-hour. The water rental of 0.46 cent per kw-hour made a total of 0.84 cent for coal and water. Only one of the three plants that rented water-power appears to have saved anything over the probable cost of coal alone, and in this instance the cost of 0.53 cent for both coal and water was obtained with the total flow of the river at one fall and a great part of the flow at the other.

The following instances illustrate the prices sometimes paid for conveniently located water-power sites to operate electric systems: In one instance the fall of a small river at the purchased site was 10 ft. with normal rate of flow, and the price paid for both banks of the stream with the right to the total discharge was $50,000, or $5,000 per foot of fall. This price included about 1.2 acres of land on both sides of and in the bed of the river, a wooden crib dam of uncertain age and condition, and several old mill buildings, one of which serves as the generating station. On the spillway the length of this dam is about 110 ft., the stored water behind it extends some four miles upstream, and the ponds of other developments on the river add to the constancy of the available power. The discharge of the river at the site in question is unknown, but this site is about 30 miles from its source in a chain of lakes, and at a point 31 miles further down stream the minimum discharge was 130 cu. ft. per second and the mean discharge 1480 cu. ft. in 1908. During that year the least mean discharge for any month was 290 cu. ft. per second. The valley of this river remains of about the same width between the points in question, and perhaps one-half of the above discharge may be available at the purchased power site. At the fall of 10 ft. each 100 cu. ft. of water per second develops 113 gross water hp. The present installed capacity of electric generators at this water-power is only 220 kw, but a higher development is probably warranted. With this 220 kw the price of $50,000 paid for the site and the old hydraulic structures amounts to $227 per kilowatt.

In another instance a site where an old dam gave a fall of 16 ft. was sold for $29,000, including the entire flow of the stream; but the situation was such that the construction of a contemplated new dam would give a fall of 20 ft. The new dam had a spillway 200 ft. long and the pond behind it is 320 ft. wide. Based on the new head of 20 ft. the price of $29,000 amounts to $1,450 per foot of fall. This power site included two acres of land on both sides of a small river at a point above which the drainage area is about 360 sq. miles. At a point several miles further down stream the mean of a large number of discharge measurements taken during a week of October, 1908, was 73 cu. ft. per second. At that time the river was low, and the discharge of 73 cu. ft. per second at the head of 20 ft. developed 165 gross water hp. Before this power site was sold the generators at the old dam where the head was 16 ft. were rated at 250 kw, but it is the purpose to install a much larger capacity at the new dam. On the basis of 250 kw the price of $29,000 for the site amounts to $116 per kilowatt.

In a third instance a water-power site with land on both sides of a river and flowage rights and the entire discharge at a fall of 14 ft. was sold for $37,400, or $2,529 per foot of fall. This is an exceptionally good power, because the flow of water is well maintained in dry seasons. At this fall generators of 800 kw total capacity were installed for operation, with the entire flow of the river, so that the $37,400 paid for the site amounted to $47 per kilowatt of generator capacity. Subsequent operation has proved that the installation of 800 kw on this 14-ft. fall was warranted by the flow of the river, for during several years the generated output of this plant has represented a load factor of not less than 47 per cent annually, based on its rated capacity during 8760 hours, and in one year this load factor was over 60 per cent. This last-named plant illustrates the strong points of even small water-powers where natural or artificial storage gives a large low-water flow.

The above figures for the costs of water-power sites are tabulated below:

Fall at Site. Ft.	Generators Installed. Kw.	Cost Power Site. Dollars	Cost of Site Per Ft. Fall. Dollars	Cost of Site Per Kw. Dollars
10	220	50,000	5,000	227
14	800	37,400	2,529	47
20	250	29,000	1,450	116

In considering the figures that relate to generator capacity it is to be remembered that the 220 kw and 250 kw are for the old equipment and are subject to increase, while the 800 kw was new plant selected for the situation.

INVESTIGATION OF ENERGY TRANSMISSION IN MASSACHUSETTS.

The Massachusetts Gas and Electric Light Commission gave a continued hearing at Boston on Sept. 15 upon Resolve 55 of the Legislature of 1910, requiring the board to investigate the transmission of electricity in bulk in the State and to report to the Legislature of 1911 its conclusion regarding the necessity of any legislation upon the general subject. The full board was in attendance, Chairman Barker presiding. As in the previous hearing of July 14, the discussion centered upon the question of granting the right of eminent domain to electric supply companies, including both central station and transmission organizations.

As a result of several conferences with electric service interests Mr. W. Rodman Peabody, of Boston, counsel for the Amherst Power Company, submitted a tentative bill granting the right of eminent domain to transmission companies, electric light companies and gas companies doing an electrical business. The bill provides that the directors of such a company may apply to the Gas and Electric Light Commission for a certificate of exigency, which shall state that the construction of a specified line for the transmission of electricity in the different municipalities named in the application is consistent with

the public interest. With the application the directors are required to file a map of the proposed line and an estimate showing in reasonable detail the cost of construction. The company is also required to file with the board various data regarding its stock and bonds outstanding, balance sheet within three months of the application, and certain details regarding its officers and directors and their annual salaries. The company is further required to publish a copy of its application in the local press, to send a copy of the application to municipal clerks, and to appear at a public hearing upon the question of exigency. After the hearing the board shall, if in its opinion the construction of the line is consistent with the public interest, grant a certificate to that effect, and a copy of the decision is to be sent to the clerk of each municipality through which the line passes, setting forth the route appropriately. The bill provides that if the board refuses to issue the certificate no further proceedings may be had within one year.

In case the board grants the certificate, the procedure is similar to that followed in the exercise of the right of eminent domain by electric railroads under the law of 1906. Within sixty days the directors of the company may make application to the municipal authorities of each town or city through which the line is to pass for a detailed location, with a suitable map, and after due notice and public hearing the municipal authorities may fix the route, or with the written agreement of the directors may fix a different route to be submitted to the commission for its approval. In case no route is fixed by the mayor and aldermen, or the selectmen, within 60 days of the filing of the company's application with them, the directors may appeal to the commission to fix the route, and the latter is authorized to fix the route except that it may not be longitudinally upon any public way or place without the written consent of the aldermen or selectmen. A certified copy of the commission's decree is then to be sent to each municipal clerk concerned. In fixing the route locally the municipal authorities are permitted to specify where all poles, towers, etc., in the public streets or places shall be placed, the kind of poles, towers and other structures, and the height at which and the places where the wires shall run.

The most important section of the bill is that providing for the exercise of the right of eminent domain. A company which has obtained authority to construct a transmission line under the provisions of the proposed act may lay out its route not more than 100 ft. wide, and if it is unable to obtain such land or such rights or easements therein as are necessary for the construction of its line by agreement with the owner, may take any land within the limits of its location in fee, or may take such rights or easements therein as are proper for the construction and maintenance of such poles, towers, wires and other structures as may be reasonably necessary from time to time for the conduct of its business. The company is required to pay all damages caused by the laying out, construction or maintenance of the transmission line or by the taking of land or of any rights or easements in land, and such damages upon application of either party are to be estimated by the county commissioners in the manner provided for the laying out of highways. The right of the company becomes null and void unless the line is constructed over the route fixed within two years after the location is determined, but the commission may extend the time if it deems it consistent with the public interest. The bill provides that the company shall not sell electricity in any municipality through which it passes unless it has been or is particularly authorized to do so by the municipal authorities. Any corporation, company, or person aggrieved by the action of the municipal authorities may appeal to the commission for adjudication of the matter. After a hearing the board may affirm, amend, alter or add to the terms imposed by the municipal authorities, as the public interest may require. Upon the petition of any party interested, the board may also make such orders regarding the construction and maintenance of lines or the characteristics of electrical energy transmitted. As to that part of the line on public ways, it may make such orders as to its maintenance overhead or underground as it may deem necessary.

Mr. Peabody said that his clients feel that the provisions of eminent domain as incorporated in the bill are constitutional, and that the time is soon coming when small companies which generate electricity by coal and deliver over small areas will be doomed, so far as manufacturing is concerned, and that they will mainly be distributing agencies. The tendency is in that direction, notably in Germany, England and the West. The right of eminent domain is in the public interest for the reason that persons in the communities served are now paying more for the service of the energy companies than would be the case if the additional cost of lines due to attempts to extort exorbitant prices were eliminated.

Gen. Schaff, of the commission, said that the exigency must be reflected in the act which gives it relief, and questioned the wisdom of opening the door so widely, particularly in regard to central-station organizations. Mr. Peabody then stated that if the right of eminent domain is withheld from central stations and given to transmission companies the tendency will be for the former to organize transmission companies for the extension of their service into larger areas. It is felt that the power given to the board to supervise the granting of a certificate obviates any opportunity for the entrance of abuses.

Mr. Frederick M. Ives, for the Massachusetts Electric Lighting Association, said that if central stations could obtain locations in spite of obstructive tactics on the part of municipal authorities, they would not urge the eminent domain grant He said that if the State waits for an exigency to arise the damage will have been done and the public will have to pay more for its service than would be the case if excessive charges had not been made for line locations. If a municipality should try to revoke the locations already granted to a private company, assuming that a municipal plant was voted for, how could the central station get its locations for energy transmission? He related difficulties which the Boston Edison Company had suffered in locating suburban high-tension lines, and urged the desirability of legislative authority to set aside obstructive policies in local centers.

Mr. Peabody then said that in the recent construction of a high-tension line to deliver hydroelectric energy from Turner's Falls in Easthampton and Amherst many difficulties were encountered, and there was no question that the line was more costly than if the right of eminent domain could have been exercised. It would be necessary to act under an eminent domain law if the service were to be extended to Springfield or Holyoke from Mount Tom, for example. Gen. Schaff said that he had no idea of embarrassing the healthy growth of the industry, but he was somewhat anxious lest the power of eminent domain be abused if granted. He thought it a good deal of a problem to know where to draw the line, and noted that the term "electricity in bulk" was not concretely defined by the resolution under which the commission is conducting the investigation. He asked why a gas company should not be given the right to transmit gas over private land under right of eminent domain, and Mr. Peabody replied that the gas company can serve the public in the highways, whereas the transmission company cannot safely do so. Mr. Peabody emphatically stated that the commission ought not to take a single step toward recommending the grant of eminent domain rights unless on the ground that lower rates would be afforded by the reduced investment. The right must be for the benefit of the ultimate consumer. Companies are to-day prohibited from extending lines in many cases to sell electricity at a low price by the obstructive charges of landowners. It will not do to send energy at high voltage along the highways on account of the danger. He did not fear the expansion of municipal plants under an eminent domain law, for these are almost always local in scope.

Commissioner Weed raised the point of the companies running lines through houses, barns, etc., under eminent domain, and Mr. Peabody answered that in his opinion the citi-

zen is amply safeguarded by the bill, which provides for close supervision by the municipal authorities and the commission. The right of appeal is most valuable in this case. He further contended that a transmission line can seek a particular alignment more easily than a railroad, which would obviate many of the troubles encountered in the exercise of eminent domain by transportation companies.

Gen. Schaff asked about the belief that a transmission company sells to individuals locally, and Mr. Peabody stated that the best plan is for the local company to buy and distribute energy from the trunk line. Mr. Alton D. Adams, for the town of Leominster, raised the point that it would be unconstitutional for the right of eminent domain to be granted to private persons except on condition of public use of the service. He contended that the restriction of certain electrical companies to a limit of supply, as in the Fitchburg and Worcester cases against the Connecticut River Transmission Company, rendered it unconstitutional to grant the right of eminent domain for the sole purpose of reaching a selected group of customers. Private property can be taken only for public use, and if a man's land is taken and he cannot then turn around and demand a supply of the service, the taking is in violation of the State and federal constitutions.

Chairman Barker called attention to the definition of supply of electricity in bulk given in the English Electric Lighting Act of 1909, as a concrete expression of the term in mind in the resolution, covering the supply of electricity to any locally authorized company or person authorized to distribute it, or to anyone authorized to contract for it for the lighting of streets, bridges and public places.

Mr. S. H. Pillsbury, counsel for the Connecticut River Transmission Company, contended that the companies have leaned over backward in their willingness to submit to regulation. The proposed bill does not even allow an appeal from the action of local authorities in connection with a line passing longitudinally through the streets. Nothing is asked which in any way cuts into the power of local authorities, and the constitutionality of the bill did not seem questionable to him. He understood that the local authorities could absolutely refuse permission for a line to go through the town. The exigency must be met by cheaper rates.

Mr. Henry I. Harriman, president of the Connecticut River Transmission Company, outlined the special fields of service applying to his organization. He thought that more consideration should be given to the ratio of distribution to manufacturing cost. His company had no desire to enter the purely lighting field, on account of the relatively high cost of such service compared with the generating cost in the hydroelectric station. He thought it would be worth while to make studies of the average cost of serving groups of customers, since in most towns the industrial districts are rather closely related, following a railroad or a river. Manufacturing follows certain general axes. The eminent domain bill is justified by the fact that it is impossible to run a high-tension line over a deflected route except at very great cost. In one noteworthy case the line had to be terminated several miles from the urban center on account of the obstructive tactics of landowners, and consequently the distribution in that city is faulty from the engineering standpoint. Mr. A. D. Adams, resuming, said that he did not oppose the granting of eminent domain for any public purpose, but that he opposed its private application.

Mr. M. B. Jones, for the New England Telephone & Telegraph Company, urged that there is no difference in principle between the transmission of electricity in bulk and for conducting intelligence. The right of eminent domain is needed by telephone companies, under all proper restrictions. Anything which tends to cut down the line investment tends to afford a basis for lower cost of service. In closing, Mr. Jones said that in Vermont the existence of eminent domain rights is of great assistance to the company in making purchases of real estate in connection with the reconstruction of its main toll lines. The hearing was then continued by the board to Sept. 27.

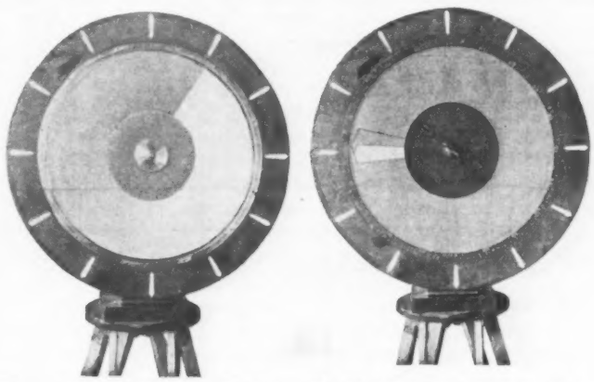
A VARIABLE CONTRAST TESTING DEVICE.

By Preston S. Millar.

In the course of tests of street illumination conducted for the lamp committee of the Association of Edison Illuminating Companies need was felt for a means of determining how well one could see with the light provided in the street and meas ured by means of a photometer.

Consideration of processes of discernment led to the con clusion that practically all seeing in the street at night is a matter of discernment of contrasts. The intensity of illumination is generally so low and objects to be seen are usually of such low light-reflecting power that distinction of detail and perception of most colors is impossible, so that practically all vision is reduced to a basis of contrast discernment.

Ability to see, whether involving visual acuity, color discrimination or shade perception, is so variable, depending not only upon conditions external to the observer, but also upon the observer's condition, that no attempt to measure perception can be successful in establishing precise and definite values. Most of the methods of study which are applicable involve more or less difficulty, due to influences of memory upon judgment or to a tendency on the part of observers to think that objects are seen when they are not seen.



Figs. 1 and 2—Testing Device with Dial Exposed and Equipped for Use.

These considerations were in mind when it was determined to devise some means of measuring the ability to see objects in the streets at night. Three basic conditions were at once established which should be met in the design of a device to accomplish the purpose: (1) The device should test the observer's ability to discern contrasts; (2) it should be so constructed that it may be located in the street and may be observed from some such distance as that at which the objects in the street are most usually observed; (3) it should be free from difficulties of visualization.

After considerable thought, and with the aid of associates at the Electrical Testing Laboratories,[1] a device was evolved which seems to satisfy the requirements fairly well. This device is illustrated in Figs. 1 and 2. It consists of a circular dial on the peripheral portion of which twelve marks are placed to correspond with the hour marks of a clock. The central portion is a surface which is shaded gradually from black, through the grays to white. This part of the construction is illustrated in Fig. 1. The shaded surface of the dial is covered by a disk of dark-gray paper of fairly good diffusive quality. The disk is provided with a slit of variable width corresponding to the hand of a clock. The disk revolves, exposing to view, through the slit, any desired portion of the shaded surface, giving a wide range of contrasts, any degree of which may be quickly presented to view. As the construction is such that the shaded dial also may be revolved upon its center, any desired degree of contrast may be secured either by revolving the shaded dial with the slit stationary or by revolving the slitted disk with the dial stationary.

[1] Obligation is expressed in particular to Dr. C. H. Sharp, Mr. W. F Little and Mr. Norman D. Macdonald.

The contrasts which are afforded will depend upon the character of the cover disk used. This may be white, when the point of no contrast will be obtained with the slit over the white portion of the dial, or it may be black, when the region of no contrast will be found with the slit over the black portion of the dial, or it may be any desired shade of gray. In most of the work done so far with this device, dark-gray paper has been used, giving the point of no contrast about 70 deg. from the darkest portion of the dial. When thus equipped the calibration of the device is as shown in Fig. 3, with illumination intensities as abscissas and with per cent contrasts as ordinates. The contrasts are very great, as may be expected when one remembers that the intensity is low and the distances are relatively great as experienced in practice. In addition, the object discerned is small, the diameter of the entire device as used in these tests being 15 in., while the slit in the cover disk is only 4 in. long.

For higher intensities, larger objects and near vision, as in interiors, one's ability to discern contrasts is believed to follow Fechner's "law of sensation," according to which one perceives a fixed percentage of contrast irrespective of the absolute intensity of illumination within wide limits. It is known that this law does not hold for very low intensities. The

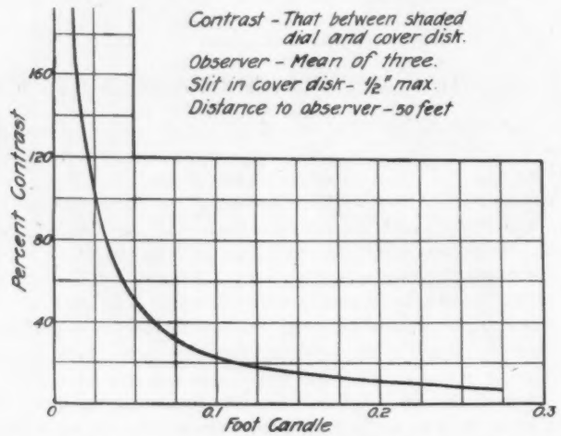


Fig. 3—Calibration of Testing Device—Minimum Illumination with Which a Given Contrast May Be Perceived.

calibration of this device follows another law; namely: *The minimum perceptible contrast varies inversely as the illumination intensity.*

The device is by no means an instrument of precision, but by averaging a sufficient number of observations a fairly definite result is obtained. After a little practice most observers make fairly consistent settings.

A number of possible procedures in the use of this device will suggest themselves. That usually followed in tests of street illumination is as follows: The shaded dial is adjusted to a condition of no contrast, and the slit is held stationary at some point on the dial. The shaded dial is revolved slowly by an attendant, the contrast being gradually increased until the observer at some distance, say, 100 ft., can just discern the contrast. The observer demonstrates his ability to discern the contrast by designating the time indicated on the clock device by the slit in the cover disk. The dial is then revolved by the attendant until the point of no control is reached and the operation is repeated. If steps had not been taken to guard against such contingencies, the observer in preparing for a second setting would know the portion of the dial upon which his second setting would fall and he would know the appearance which the slit would present when seen. He would, therefore, be liable to think that he saw it before it became visible. To obviate this difficulty, the attendant at the device, in preparing for a second setting, turns the shaded dial through a part of a revolution after having brought the disk slit to the point of no contrast. Having arranged that the degree of contrast obtained in the first trial will in the second be obtained upon a different portion of the dial, he gradually increases the contrast until the position of the slit is located by the observer, who again designates the time indicated by the slit, thereby giving proof of his ability to see it. That this precaution is necessary is attested by the fact that after using the device for some time, always working with the minimum intensity with which a given contrast can be discerned, an observer often imagines that he sees more than one slit on the dial and very frequently thinks that he sees the slit when he does not see it. Indeed, no observer who worked upon the device for any considerable length of time proved free from this difficulty; each one at times indicated that he could discern the contrast when the fact that he was looking at the wrong portion of the dial proved that he did not discern it. The value of this feature lies chiefly in assisting the observer to fix and maintain a definite criterion of discernment, and in pointing out unreliable values in the test results.

In street tests of glare, the contrast device just described was placed in the street at the position where the extent of the glare effect was to be measured and an observer was stationed at a distance usually of 100 ft. Determinations were made of the minimum contrast which could be observed; first, without modifying the conditions; second, with all lamps shielded from the eyes of the observer. This was effected by erecting immediately behind the contrast device a large black cloth screen to obscure all distant lamps from the observer's view and by shielding the observer's eyes locally from the direct light of nearby lamps. Under this condition the contrast device received the same illumination as before, but was observed under conditions of no glare except that which might be due to nearby illuminated surfaces, such as the street. In each test a number of observers were employed and a photometer was placed alongside the contrast device in order to measure the intensity of illumination on the dial. By this means it was in each case either ascertained that the intensity was substantially the same for the glare and no-glare observations, or in the event that the intensity varied the results were corrected for such variations by reference to calibration curves such as that shown in Fig. 3. If the illumination intensity was so low, or the glare was so marked, that with the maximum contrast the position of the slit could not be determined, the slit was widened or the distance between the observer and the contrast device was decreased. It was found, however, that the range illustrated in Fig. 3 would meet nearly all conditions.

Visual acuity instruments which involve discrimination of fine detail, a rather large contrast being presupposed, are employed in tests of illumination. A well-known application is sometimes in the form of reading-distance instruments where the test is the ability to read print of various sizes. Other applications will be recalled by those who have followed the subject.[2]

The variable-contrast testing device here described differs from the visual acuity test objects in a number of important particulars. First, it tests ability to perceive contrasts, which is the more common process of seeing in the streets at night, rather than ability to discriminate fine detail, which is more likely to be involved in a process of seeing in interiors where much higher intensities of illumination prevail. Second, it is free from visualization effects.[3] Third, it presents to view an object which is always of the same size and appearance. Fourth, it is continuously variable throughout a great range.[3]

This variable-contrast device has been found very useful in studying the effect of glare, as encountered in street lighting. It aids a determination of the reduction in power to see objects in the street with the aid of light incident upon them.

As compared with visual acuity test objects this device is believed to be applicable to a somewhat different field of study. Where it may be used in the same field it may be found useful in that it affords a different method of study, and as

[2] Among the more recent applications are those devised by Sweet and others, *Journal*, Franklin Institute, May, 1910, and that of Ives, described in the *Electrical World*, Vol. LV, Page 939.

[3] This statement applies also to the Ives test object.

compared with most visual acuity test objects it should be useful because it is much more direct and convenient. As a means of studying the peculiarities of vision it would also appear worthy of trial because of its convenience, simplicity and continuous fine variation throughout the entire range of adjustment.

Central Station
Management, Policies and Commercial Methods

ELECTRIC WIRING CONSIDERED AS AN INVESTMENT.

In a new-business campaign now being carried on among unwired houses in a Western city effective use is being made of the "investment" argument for electric wiring. After pointing out that a six-room house may be equipped with fixtures and wired complete from basement to attic for $59 the letter received by the prospective customer shows how $60 spent in wiring a house often means, in the real-estate man's opinion, an immediate jump in the value of the property of $100 or more. This aspect of electric wiring as an investment for doubling one's money often appeals to the canny landlord or householder with an argument more pointed than all the other ideas of mere convenience, modernness or superior safety incident to electric lighting of his property.

INTERESTING CENTRAL-STATION MEN IN COMPANY AFFAIRS.

One of the benefits resulting from the organization of company branches of the National Electric Light Association is the publication of magazines by these various local societies in the larger cities designed to interest the members in the advancement of the company and leading to a wider knowledge of, and a deeper insight into, the workings of the various departments and their correlation. To this end it is desirable to make these little magazines bright and readable, and this purpose has been accomplished admirably in the case of *The Edison Round Table,* published in Chicago by the Commonwealth Edison Branch of the N. E. L. A. This publication is handsomely printed on fine paper, is illustrated and forms a creditable example of high-class magazine work. Its contents are varied and interesting, relating to the varied activities of the Commonwealth Edison Company, and the editor, Mr. Ernest A. Edkins, and his associates add just the touch of sprightliness which gives zest to the whole and does much to make each issue eagerly awaited. Clever and amusing cartoons are also a help in this direction. It is safe to say that every number is read from cover to cover by nearly everybody in the company's organization, and thus a solidarity of followship and effort is attained which it would be difficult to secure in any other way.

FLAT-RATE COMMERCIAL AND RESIDENCE LIGHTING IN INDIANAPOLIS.

For the past month the Merchants' Heat & Light Company, of Indianapolis, Ind., has been conducting a controlled flat-rate new-business campaign among the business houses and residences reached by its lines. To these new consumers the company offers a flat rate of 1 cent per month for each watt of demand contracted for. The minimum bill under this arrangement is $1 per month, and all accounts are payable in advance. The 1-cent rate applies to residences, apartments and short-hour business places which close before 8 o'clock in the evening. To those requiring long-hour service, until 12 o'clock midnight, 2 cents per watt is charged, and all-night consumers are required to pay 3 cents per watt demand. Flat-rate controllers of the Excess Indicator type are used, which notify the consumer when he is exceeding his demand, but no limitation is placed on the number of lamps which may be connected to the circuit. Any tendency to waste energy by useless long-hour burning on the part of the consumer is controlled by having the customers buy their own lamps—tungstens being chiefly used—which the company sells at cost. The reception given this new rate by customers has been very satisfactory, reports Mr. E. Darrow, general manager of the company. The average demand contracted for varies from 100 watts to 175 watts per month. To permit the use of electric heating and cooking appliances by consumers whose short-hour demand would probably make the monthly bill prohibitive the company provides special flat-rate service taken off its lines behind the flat-rate controller, and charges 60 cents a month for the privilege of using a flatiron, and 25 cents a month for a toaster or percolator.

ELECTRIC VEHICLE CHARGING IN DETROIT.

Detroit is a beautiful city of splendidly paved streets where everybody rides in automobiles because the city is practically the capital of the gasoline-vehicle industry in this country; but probably the greatest stimulating factor in the use of the many electric automobiles seen there has been the low cost of storage-battery charging energy as sold by the Detroit Edison Illuminating Company.

To the private garage owner this company offers a special rate of 4 cents per kw-hour for energy used to charge automobile storage batteries when registered by a separate meter from other services. The only limitation placed on the customer is that he shall not use energy during the hours from 3 p. m. to 7 p. m. in the months from October to March inclusive. His total bill is subject to 10 per cent discount for prompt payment, and in any case he is charged a minimum amount of $1 per month.

To the public-garage owner the company holds out still greater inducements, offering the choice between a special garage rate and the low regular "energy" rate, which latter is the term very properly applied to motor service by the Detroit company instead of the technically inaccurate "power" designation which has wide usage in this country. The public garage rate is 3 cents per kw-hour, and under this agreement the garage owner accepts the same hourly limitations as given in the preceding paragraph. On bills of less than $50 10 per cent discount is allowed for prompt payment. The regular "energy" rate which the garage owner may select if he chooses employs a base rate of $4.50 per month for each kilowatt of demand, to which is added 1 cent per kw-hour for all energy consumed. Under certain conditions of especially satisfactory demand this base rate is reduced to $3 per month per kilowatt of demand. As a result the average cost of energy to the public-garage owner is as low as from 2⅓ cents to 2⅔ cents per kw-hour.

There are now about 400 electric pleasure vehicles in use on the streets of Detroit and about twenty-five electric trucks. There are nearly 200 private garages in the city, the majority of which take advantage of the special rate offered this class of business, with the result that the average cost of energy for charging a private machine is about $6 per month. A number of owners purchase their battery-charging energy along with their house service, through the same meter, and so no record is kept of the automobile operating costs under these conditions. The public garages charge $30 a month for charging, cleaning and delivering a private automobile.

While in Detroit no especial means have been employed to

encourage the use of electric automobiles the low rate for battery charging offered has, as in the case of the well-known large small-residence lighting business in that city, tended to popularize the electric vehicle and to build up the present satisfactory charging load.

UNUSUAL INSTALLATION OF MOTOR-DRIVEN PUMP IN DEEP SALT MINE.

An unusual installation of a motor-driven pump is that recently added to the lines of the Detroit Edison Illuminating Company for freeing one of the salt mines of the Detroit Salt Company from ground water which finds its way into the workings. The silurian rocks underlying a wide area in the vicinity of the city contain large deposits of rock salt at a depth of about 750 ft. to 1000 ft. below the surface. The usual method of recovering the salt from these beds is to pump water down into wells leading to underground caverns in the rock salt, producing brine by solution, which returns to the surface, where it is run out into evaporating beds to concentrate and precipitate under the action of the sun. In the installation referred to, however, the rock salt is mined directly in its crystal form. The original shaft was sunk with much difficulty, as a result of encountering several underground streams, and after the actual mining operations were begun it soon proved to be impossible for the workmen to stay in the chambers for more than half an hour at a time on account of the sulphurous fumes liberated from the mine water, by the heat from the steam-driven pump, which had to be operated continuously to keep the shaft free of water. As the pump was at the 750-ft. level the large condensation in the steam line also made operation unsatisfactory in point of expense. A compressed-air lift was next considered, but this idea was abandoned on account of the inefficient performance of such an installation. Accordingly electric pumping was resorted to, and duplicate equipment installed as reserve against possible breakdown. These pumping units comprise 225-hp, 440-volt squirrel-cage induction motors, direct-connected to six-stage centrifugal pumps delivering 750 gal. per minute against the head of 750 ft. As this installation runs at a comparatively low temperature, the former dissociation of the sulphur gases dissolved in the mine water is avoided, and the workmen now remain in the shaft throughout their shifts without sign of discomfort. On account of the destructive action of the sulphur and salt-laden moisture everywhere in the mine, special precautions had to be taken to enclose the motors and protect all wiring in lead-covered cable. Special weatherproof sockets are used in the lighting of the underground passages. The fully loaded pump takes 208 kw, and as this is a twenty-four-hour load almost within the city limits the service is an especially satisfactory one from the central-station viewpoint. This installation obtains a rate of less than 1 cent per kw-hour for the energy it consumes.

ELECTRIC VEHICLES IN TOLEDO, OHIO.

Toledo's level and well-paved streets and large colony of well-to-do residents, among whom the electric vehicle has become almost a fad, have combined to cause the unusual proportion of 700 electric vehicles found in this little city of 170,000 by the last census. Besides the pleasure vehicles above referred to there are at least twenty-five electric trucks in commercial use.

The number of private garages equipped for charging electric automobiles is estimated by Mr. T. D. Buckwell, contract agent of the Toledo Railway & Light Company, which supplies the electric service, to be about 400. These private-garage owners obtain a special rate of 5 cents per kw-hour for all energy used to charge their storage batteries when measured by separate meters. For this service the minimum monthly bill is $3. The majority of the private-garage customers have installed mercury-vapor rectifiers, as the distribution lines are alternating current, although a small remaining territory is served with 220-volt direct current in the residence section.

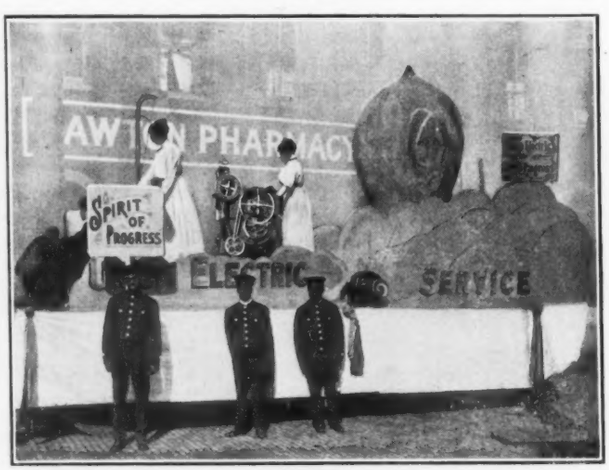
There are two large garages in Toledo which make a specialty of caring for electric vehicles, and each of which has live-storage quarters for more than 100 machines. These charging stations purchase energy at an equivalent rate of from 2.5 cents to 3.0 cents per kw-hour, on the same basis as the "power" or motor-service rate. The cost of "boarding" an electric machine in these places is from $20 to $22.50 a month, which includes charging and care of battery, washing and delivering. There are also several smaller charging stations in which even a lower monthly rate is charged. These garages also offer a special rate of 50 cents per charge for an ordinary electric automobile, which has proved an attractive inducement to many owners who have unwired stables where they can garage their cars, running them out to the charging station to be replenished when necessary.

A distinctive feature of the Toledo electric automobile situation is the large variety of types of machines in use. All of the representative manufacturers have agents in Toledo, and the cars in use there include, besides the customary runabouts and enclosed coupés, many double-seated surreys and limousine patterns. The average income to the central station from the private garages under the 5-cent rate is from $5 to $9 a month

CENTRAL-STATION FLOAT FOR DAYLIGHT PARADE.

One of the interesting features of the industrial parade given under the auspices of the Million Population Club in St. Louis on Oct. 6 was the float of the Union Electric Light & Power Company. It was a daylight parade, and so the electric-service company was unable to utilize the effects of electric lighting, as it might have done in a celebration conducted after dark. However, the float was a striking one, as may be judged by the accompanying illustration.

A conspicuous feature was a large papier-mâché model made to represent an incandescent lamp bulb. This was 8 ft. high,



Daylight Parade Float.

and in front of it was stationed a man in costume representing the figure of "St. Louis." In front of this man (who is not shown in the picture) was a woman operator busily at work at an electric washing machine, which was shown in operation. The clothes thus washed were passed to another woman operator who ironed them with electric flatirons. On each side of the float was a 5-hp electric motor with the end of the pulley painted to indicate the direction of rotation. These motors were supplied with electrical energy from a storage battery on the truck, which was an electric truck transformed for the occasion. Four of the company's colored porters were stationed at the corners of the truck and walked along with it in the parade as an escort.

SOME ASPECTS OF ELECTRIC GARAGE MANAGEMENT.

The patron of a public garage who acquires his own charging outfit for his electric automobile and compares the cost of home charging with the amount previously paid to the garage management will be difficult to convince that there is a real basis for the higher rate of the public establishment for handling the same automobile. The most important factor in this actual difference in the energy consumption of a car in a public garage and the same vehicle under private supervision is the familiar element of human nature expressed in the saying: "Get your money's worth." As a result of this a car in a public garage is used much more freely, and even needlessly, by its owner than when his mileage is paid for in terms of kw-hours on the electric company's meter. The electric vehicle for whose maintenance a fixed charge of $20 or $30 a month is paid, without regard to mileage, is often run 40 miles or 50 miles a day, if only in half-hearted pleasure seeking, until the battery voltage shows the cells to be nearly exhausted. Then the garage man is summoned to return the car and finds perhaps barely enough remaining "charge" to get the machine back to the charging station. The wear and tear on the battery and the rapid deterioration of the plates under such conditions can be surmised. Another factor in the increased charge demanded by the car in the public garage is the distance of delivery and return from the owner's residence or place of business, which must be added to the regular mileage made by the car. Where this distance is great, or the car is called for daily, the delivery mileage mounts surprisingly.

Realizing that the daily runs of the private electric vehicles in his garage varied considerably, although the practice was to put all of these machines on charge each evening when they came in, the proprietor of a large station hit upon the plan of advising all of his customers to purchase cyclometers for their machines, as a means of "determining the life of their batteries." After succeeding, through continued suggestion, in getting the counters on most of his automobiles the night men were then instructed to read the dials each evening, recording the daily trip totals in a book for the purpose. From these records it was possible to tell how far each automobile had traveled daily, and if this distance did not exceed ten or fifteen miles the car was charged only at two-day or three-day intervals, no one being the wiser except the canny garage owner, who was thus able to slice a good percentage from his electric bills.

Nor is the outlay of the garage proprietor only for electrical energy, labor and store rent. Two of the most important of the shifting factors that determine the margin between profit and loss in this business are the risks of personal injury and property damage which may be done by some employee through carelessness or ignorance in handling a machine in the garage or on the street. Injury to pedestrians or persons in the garage building and collisions or accidents to customers' property or other vehicles are the real ghosts which haunt the proprietor. A damage suit from a serious accident may wipe out his business, or the destruction of a customer's car will absorb a year's profits. Added to this is the constant nagging in regard to minor injuries, thefts, etc., that go on in the semi-public place of the average garage, where the labor employed is sometimes of a very irresponsible class. Custodian of thousands of dollars' worth of valuable equipment, any damage done on or inflicted by any of these machines when in charge of one of his employees returns upon the responsible proprietor. This aspect of garage management has not received proper consideration.

An example of the peculiar accidents which may happen in even a well-ordered garage was the expensive one which occurred in a Western charging station while an electric vehicle, just off the road, was being washed up. During the process water collected in some part of the motor, which happened to be so wired that only this bridging path was needed to complete the circuit and energize both field and armature, and the machine started up at increasing speed while the attendant's back was turned. He looked around just in time to see it cross the floor at a good rate and collide violently with two other cars, shattering the windows and lamps of all three and doing severe damage to the woodwork and sheet-metal bodies.

The cost of this accident, of course, like that of others while cars are in the hands of garage employees, must be charged against profit and loss. So distressing has this subject become in some instances that a garage owner will welcome and even advise the removal of customers' cars to their own private garages, feeling that no equitable boarding charge which he can make will cover the cost of risk with the machine. No other type of automobile adapts itself so well to private care as does the electric, with its absence of mechanical complication. Any woman can handle the charging appliances, and with a little occasional expert supervision of the battery good service will be secured. The average intelligence of manipulation in the private stable is probably equal to that the car will receive in a public garage, and certainly better care will be accorded the machine as far as operating use is concerned. The tendency to run the battery clear down and the delivery mileage are both eliminated.

The private-garage load is an especially satisfactory one for the central station and can frequently be encouraged with the assistance of the garage proprietors themselves, especially when the latter act as selling agents for machines and supplies. This merchandising, the garage man is often willing to admit, is really the profitable side of his business.

Wiring and Illumination

ADVERTISING A CITY BY ITS LIGHTS.

Toledo, Ohio, is lighted by 2500 magnetite arc lamps, a large number of which are employed in the closely spaced ornamental lighting of the downtown district. This installation, which was one of the first to utilize the new magnetite lamp,

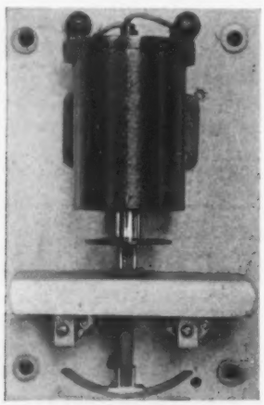
Advertising a Well-Illuminated City.

is being added to at frequent intervals as legislation is passed in the City Council directing the ornamental lighting of additional streets. Fifteen per cent of the cost of operation is borne by the city government, the remaining 85 per cent being collected in a special city tax from the abutting property owners in the proportion in which they are benefited. The energy for these lamps is supplied by the Toledo Railways & Light Company, which has issued for its customers and friends a post card showing some of the many bright spots of the town, and well calculated to impress upon the lay mind what

ample electric lighting can do to make a city distinctive. On the reverse or address side of the mailing card is a map of the downtown district showing the disposition of the double-lamp poles, at 80 ft. intervals throughout the business section. The area now thus brilliantly illuminated is five squares long and four squares wide. The operation of these lamps is reported to be extremely satisfactory, outages of less than 0.002 of 1 per cent of the total burning hours being reported from month to month.

CONTROLLING MULTIPLE LAMPS FROM SERIES ARC CIRCUIT.

Several small outlying parks and public places in Toledo, Ohio, are lighted by tungsten and Nernst incandescent units under the same hours-burning agreement as the regular city series magnetite arc lighting. As in each instance the incandescent units are supplied with energy from the neighboring 110-volt and 220-volt multiple secondary lines of the Toledo



Solenoid Switch for Controlling Multiple Lamps.

Railways & Light Company, which also does the series arc lighting, it was formerly necessary to send a patrolman around to each one of the multiple installations both night and morning to turn on and off the lamps.

However, this expense and trouble has now been avoided by devising a solenoid switch, the winding of which is inserted in series with the nearest arc circuit and has its contacts controlling the multiple-lamp circuit. Thus when the series-arc circuits are started up the switch automatically closes, turning on the multiple lamps, which remain burning as long as the arc lamps are operated. All of the street and public lighting is thus under the control of the power-station operator, and the annoyance of sending men to outlying districts simply to turn on and off a few lamps is avoided.

The switch shown in the accompanying illustration was constructed for this purpose by Mr. W. E. Richards, superintendent of power and lighting for the company, and has proven especially satisfactory during the three years since the first one was installed. Meanwhile a number of others have been used to advantage in Toledo, and not a single outage has been reported from the multiple lamps thus controlled.

The switch as constructed in the company's shop consists of an iron-clad solenoid mounted on a marble slab 11 in. x 7½ in., as shown in the illustration. The winding comprises 320 turns of No. 13 double cotton-covered wire, and has each layer painted with insulating compound and the whole coil wrapped with cotton tape. The coil is wound on a cylinder of 18-gage brass in which the 11/16-in. iron core moves freely. This iron core is extended by a 5/16-in. square fiber rod, 4½ in. long, which passes through a fiber bushing in a supporting shelf of slate, and carries at its lower end the laminated contact pieces which complete the multiple-lamp circuit between two brass contact blocks. A disk at the junction of the iron core and fiber extension prevents the switch pieces from dropping further open than desired when the coil is not energized.

This solenoid switch will pick up at 3 amp flowing through the winding, which is so proportioned as to carry safely four or five times this current without serious heating. The contacts are designed to carry up to 25 amp.

DISCERNMENT BY SILHOUETTING IN STREET ILLUMINATION.

At a meeting of the New York section of the Illuminating Engineering Society held on Oct. 13 Mr. Preston S. Millar presented a paper entitled "An Unrecognized Aspect of Street Illumination," in which attention was called to the important part played by silhouetting in street illumination. The author remarked that the perception of small objects on the surface of the street and the detection of irregularities in the street surface are purposes which must be served by any effective street-lighting installation, but any estimation of the effectiveness of an installation is likely to fall short of correctness if these are the only factors considered. The discernment of larger objects on the street, such as pedestrians and vehicles, is of at least equal importance, and in the discernment of such objects other factors than those already discussed must be considered.

The light incident upon the near surface of a large body, such as a pedestrian, is either sufficient or too feeble to render him visible. If sufficient, the pedestrian can, of course, be seen; if too feeble to make him visible, it does not follow that he cannot be seen, because in most street-lighting installations the incidental light does not form an adequate criterion of the conditions of discernment of large objects. It may even occur that with decreased intensity of light upon the object it may be discerned more clearly, and, conversely, that with increased intensity of light upon the object it may be discerned less clearly. For example, in a particular instance a pedestrian wearing clothes of substantially the same light-reflecting power as the street surface is seen by reason of the light falling upon him when he is near a lamp; but he is barely discernible when, in walking along the street, he reaches a locality in which the light reflected from his clothing is about the same as the light reflected from the street which serves as a background against which he is viewed. As he proceeds along the street away from

Vehicle in Silhouette by Street Light.

the observer and from the nearest lamp, the light falling upon him becomes less intense, and he would be less easily discernible if dependence were placed alone upon incident light. As a matter of fact, the pedestrian is more easily perceived than when near the lamp, because, as less light is reflected from him to the observer, he becomes more darkly *silhouetted against the background*, which is chiefly the street at a distance. In street lighting, as a rule, large objects on the street are seen as silhouettes.

In the accompanying illustration is shown an example of such a discernment. The automobile shown was 300 ft. from the camera and nearly 200 ft. from the intermediate lamp. If one had to rely upon the light falling upon the automobile, discernment would be out of the question, but the relatively bright street surface which serves as a background makes it easily visible even with the small flux of light there available. In the photograph one detects the presence of an object because portions of the brightly lighted street surface and trees are obscured. The outline of the obscuring object is recognized as that of an automobile. The presence of the automobile is apparent not because one sees it, but because one fails to see the lighted background within the outline of the object. The phenomenon is simply an eclipse. The author expressed the opinion that this process of discernment is the most usual and the most important in street illumination. It depends upon a contrast between the object to be discerned and the background, which is usually a street surface, at a distance of from one-sixteenth mile to one-quarter mile. Naturally the only factor which is here under control is the brightness of the background. As most objects to be discerned are dark either by reason of low light-reflecting power or low intensity of light falling upon them, it follows that most objects of this nature may be discerned more readily as the background is made brighter.

It is important to remember that it is the distant lamps which determine the brightness of the background. Put out the distant lamps, which affect the illumination in the observer's vicinity inappreciably, and immediately discernment of nearby objects on the street is rendered more difficult.

A fact which has great influence upon street illumination is that within wide limits the apparent brightness of a surface is independent of the distance between that surface and the observer. Other things being equal, the street surface a quarter of a mile from the observer appears substantially as bright as it would if observed from a distance of a sixteenth of a mile and from the same angle. It is very important to consider this fact when studying the influence of distant parts of the street upon the discernment of nearby objects. In order to see a vehicle or pedestrian in the street it is necessary only to provide a substantially bright street, and the distance of the street surface background from an observer is immaterial, within wide limits.

Imagine a street which ends abruptly at a distance of one-fourth mile at the edge of a field. One way to make large objects on that street discernible when looking toward the end of the street would be to erect a board fence across the end of the street, paint the fence white and illuminate it brightly. In the ordinary street the distant surface is the equivalent of such a fence.

From the above-discussed facts the author concludes that the perception of large objects in the street is accomplished by the aid of light falling upon the objects when they are in the immediate vicinity of a lamp, and elsewhere when for some reason or other there is no bright background against which they may be contrasted. Most frequently, however, they appear silhouetted against a lighted background. As the discernment of large objects is in some cases the most important, and in all cases an important, purpose to be achieved, this is one of the essential elements of the problem of street lighting. Having failed to receive due recognition, it affords a new viewpoint from which to consider the whole subject.

SPECIAL STREET LIGHTING IN WASHINGTON.

Mr. A. J. Marshall presented before the New York Section of the Illuminating Engineering Society on Oct. 13 a paper dealing with a new street-lighting installation in Washington designed by Mr. Walter C. Allen, electrical engineer of the District of Columbia, and installed by the Potomac Electric Power Company.

The lighting of Sixteenth Street, one of the most prominent in the residence section of the District of Columbia, has recently been greatly improved in connection with the extension of that thoroughfare and the opening of the new Piney Branch Bridge, which carries it across a deep run. This broad highway leads directly north from Lafayette Park in front of the White House to and along the eastern boundary of Rock Creek Park, and is adorned by the homes of statesmen and embassies of several foreign countries. It is 160 ft. wide between

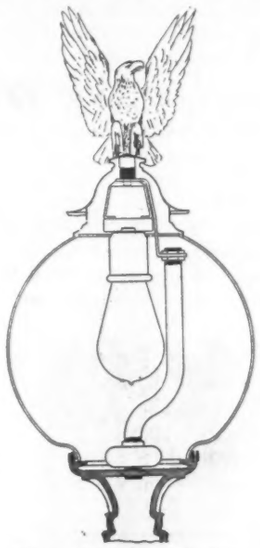


Fig. 1—Details of Lamp.

buildings, with a central 50-ft. roadway and a 15-ft. sidewalk and a 40-ft. parking space on each side. For a portion of the distance there are four rows of trees, one at each curb and one at the inner line of each sidewalk.

The old form of lighting consisted of mantle gas lamps, spaced from 150 ft. to 200 ft. apart. These lamps have been abandoned and replaced by tungsten street series lamps, with

Fig. 2—Lamp and Post in Position.

especially designed posts spaced, on the average, 60 ft. apart, measured on the axis of the street.

The lamps are suspended tip downward in a 15-in. ground-glass globe, the center of which is 10 ft. 3 in. from the sidewalk. The bent pipe serving as a support for the lamp and its socket is turned toward the houses. The method adopted in the installation of the tungsten lamps in Riverside Drive, New York, has been followed in this instance. Where there are no conduits of the electric lighting company already constructed, a

steel-armored cable was laid on the inner side of the granite curb, where the projecting concrete base would protect it from damage. At the street crossings the cable is carried under the roadway in a terra-cotta conduit.

The total distance covered by this improved lighting is 2.5 miles. Over the first mile, where the foliage is extremely dense and the travel heavy, 80-cp lamps are used, while over the remaining portion, less traveled at night and with only one row of trees on each side of the street, 40-cp, 50-watt lamps are installed, the spacing of the posts being the same in each case.

Use is made of two styles of posts, one on the street corners having a square, open frame to hold the street signs, which are of ruby glass with white letters; the other for the intermediate lamps. The ground-glass globe so diffuses the light that the inner surface of the street signs is illuminated, making it easy to read the names at night. For the designation of the

Fig. 3—Lamp Post on Piney Ridge Bridge.

streets and avenues intersecting at Scott Circle, where the angles are not right angles, it is proposed to use cast-iron plates with cast raised letters, the latter outlined with gold leaf, similar to those now in the Union Station Plaza in Washington.

The new Piney Ridge Bridge, the northern terminus of the present lighting, is a beautiful concrete structure with a single span of 125 ft., a height of 62 ft. above the stream on the center line of the arch and a total length of 272 ft. It is illuminated at present by twelve 80-cp, 100-watt tungsten lamps, three to each of the ornate cast-iron posts. The center globe is 24 in. and the smaller globes 17 in. in diameter, the center of the former being 20 ft. above the pavement. The posts are 160 ft. apart. Each post cost $482, not including erection.

RECENT TELEPHONE PATENTS.

COMBINED TELEPHONE AND TELAUTOGRAPH SYSTEM.

There have probably been very few instances where the telautograph has been combined with a telephone system, and where this has been done the system has been a small one, such as a hotel or private exchange system with the telautograph apparatus confined to the switchboard and a few special stations. Mr. F. Ritchie, of Acton, England, has, however, conceived of a system of much larger proportions, where the telautograph instruments are to be located at subscribers' stations and telephone conversations at once confirmed in writing.

He conceives the telephone stations, i.e., subscriber stations, equipped with storage batteries charged continuously from a central charging outfit. The charging current passes through the switchboard drop, but this is arranged so that a steady energization does not permit the shutter to fall. As all lines are similarly poled and all substation storage batteries likewise, no interline direct currents flow even when two lines are connected together for talking. When, however, it is desired to communicate by telautograph, one subscriber reverses his battery, which allows both local batteries to act together and through the recording apparatus of both.

CALL METER SYSTEM.

Mr. C. W. Greenslitt, of Cleveland, Ohio, has patented a call measuring device by which a line may be retained for several successive call periods, but each of which is registered as a separate call. A timing device is set in motion at the central office with the beginning of the call by the act of the calling party registering upon his counter. At the end of the stated initial period a clicking notifies the calling party of the expiration of a unit, and simultaneously cuts out his transmitter. He must then register a second call and thereby automatically restore the timer in order to restore his station for conversation on that connection.

PEG COUNTER SYSTEM.

The peg count is now considered essential to all comprehensive telephone exchange systems. Most counts are made manually upon specified days. It is the idea of Mr. C. H. North, of Cleveland, Ohio, to do this automatically by associating his counting device with all the cord pairs of an operator's position. Extra contacts are provided at the supervisory relays. One contact swings between two others. These latter are connected together so that if the circuit be carried through these contacts it is broken only during the period of swing of the middle contact. This momentary break causes the count. It is not brought out why an erroneous count is not made, due to flashing of the subscribers upon recall. The patent is assigned to the North Electric Company.

ANTISEPTIC ATTACHMENT.

An antiseptic attachment of the sheet-of-paper type has been patented by Mr. W. H. Waldron, of San Francisco, and Mr. L. R. Krumm, of Columbus, Ohio. In a square of paper of a size to cover, with a slight margin, the standard mouthpiece are cut three short slits. One of these parallels the bottom and two the two sides, respectively, and they so intersect the lip of the mouthpiece that the margins may be pressed down over the lip to form three clamping joints. From the top of the square two tongues of paper project back and are clamped by being inserted between the mouthpiece and the transmitter face.

IMPROVED RELAY.

With telephone exchange systems of the common-battery type there are two functions to be performed by the subscriber's line relays: first, the closing of the line-lamp circuit, and, second, the removal of this upon the response of the operator. Ordinarily these functions have been performed by two separate and distinct relays. It will, however, be appreciated that, since each line equipment requires its particular relays, a considerable saving can be effected if the two relays can be combined in one. It is apparently with this end in view that Mr. H. Pöser, of Hermsdorf, Germany, has designed a relay, the patent for which is assigned to the Western Electric Company. The relay takes the conventional form with a return pole piece, L-shaped armatures being used, in this case there being two of them. The armatures are carried upon the same pivot, one having its middle portion all cut away so that the other may swing freely in the opening. The relay has three pairs of springs and two windings. The outer pair are normally closed contacts, which the larger or cut-away armature breaks by lifting the top springs. It also simultaneously lifts the middle top spring. The middle contact is normally open, but the small armature may lift the lower spring to close it, whereupon it may again be opened by the lifting of the top spring. The use of the contacts will now be understood. An energization of one winding of the relay will pull the middle armature and close the middle or line-lamp contacts. The response of the operator strongly energizes the second winding, the loop armature responds, cutting off the first or line coil and opening the line-lamp circuit by lifting its top contact.

COMBINED ALARM AND TELEPHONE SYSTEMS.

A patent recently granted to Mr. W. W. Dean and assigned to the Consolidated Fire Alarm Company describes a combined alarm and telephone system. A recording device is arranged to receive the alarm, and its windings may be arranged differentially to the telephone line or a locking device may be put in one side of the line and the recorder in the other so that the recorder is locked save when current exists in its side of the line only.

Another such system, assigned to the International Electric Protection Company and invented by Mr. A. Goldstein, of New York City, provides a dual alarm. One of the alarm-receiving devices is associated with the regular telephone switchboard apparatus and a lamp is lighted whenever the circuit is either opened or short-circuited. For special protection a switch may be thrown at the central office which cuts off the telephone switchboard and connects a special signal for detector purposes.

LETTER TO THE EDITOR.

Compounding of Alternators.

To the Editor of Electrical World:

SIR:—I am indebted to Mr. T. J. Johnston for courteously directing attention, in your issue of Sept. 1, to the letters patent taken out in 1897 by Mr. E. W. Rice.

Mr. Johnston says: "Mr. Rice did not employ a separate winding on the armature of the exciter as does Professor Blondel, but passed into the armature a portion of the main alternating current, regulating the e.m.f. and power-factor by its effect upon the m.m.f. of the armature in substantially the way proposed by Professor Blondel." But, in fact, exactly this same method was described by myself at the Electrical Congress at Geneva, in September, 1896, and published at the time in electrical journals (see *L'Eclairage Electrique*, 1896) before any publication by patent or otherwise was made by Mr. Rice, to my knowledge. Without wishing in any way to lessen the high merit of Mr. Rice, I consequently feel entitled to state that my invention was absolutely independent of his own; moreover, I had it worked in Europe without any patents of Mr. Rice being opposed thereto.

Experience has shown me, moreover, that the separate field winding is, in fact, of great importance with some types of turbo-alternators, and gives the most convenient means for controlling the range of voltage and the amount of compounding at any moment. I do not believe that this double winding of the exciter was tried by others before me for the purpose of compounding.

The complication of the machines, as well as the cost of the separate windings system, has been found practically insignificant by manufacturers, and a number of these machines have operated for some years with good results and no little economy.

Paris. A. BLONDEL.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Windings for Polyphase Generators.—M. SEIDNER.—Modern alternating-current generators are generally built with two, three or four slots per pole per phase. However, in the design of a special machine, for which available sheet-iron stampings are to be used, it may happen to be advantageous to use a fractional number of slots, for instance, 2.5 slots per pole per phase. The windings in such cases do not always yield symmetry, but such windings are often decidedly advantageous. The author discusses various cases in detail with the aid of diagrams.—*Elek. u. Masch.* (Vienna), Sept. 18.

Bare Aluminum Wire for Field Coils of Motors.—At the annual meeting of the Verein Deutscher Strassenbahn-und Kleinmahn-Verwaltungen Mr. Paulsmeier, chief engineer of the Hamburg tramway system, stated that there are some thirty motors on the Hamburg tramcars with field coils made of bare aluminum wire, and that fifty-two further coils have been ordered. The absence of insulating covering and the use of wire of square section resulted in the aluminum coil taking up the same space as a copper coil in spite of the larger wire required. By their use the weight of a tramway motor of normal size was reduced by about 100 lb. This and the fact that the coils are not so easily ruined by overheating and vibration as copper coils appear to be the chief advantages. It appears that eleven other tramway undertakings in Germany are experimenting with aluminum coils, and report favorably. Most of the coils employed have asbestos, paper or linen insulation between the separate layers.—Lond. *Elec. Eng'ing*, Sept. 29.

Lamps and Lighting.

Automobile Lighting.—An illustrated description of a new system of electric lighting for automobiles devised by C. A. Vandervell & Company. The feature of the system is that the output of the generator is maintained constant by the magnetic reaction of the armature and field magnets. Two shunt-wound poles *N S* and two unwound poles N_1 S_1 are provided, as shown in Fig. 1. Commutation takes place under *N S*, as indicated by the block dots for the conductors—the brushes being in a position at right angles to the conductors. The effect of this is to cause the armature to have a demagnetizing reaction on *N S*, and thus the current does not rise above a certain value, and a constant current can be maintained at different speeds. At first sight it is difficult to see how satisfactory commutation can take place, but it is thought that this is rendered

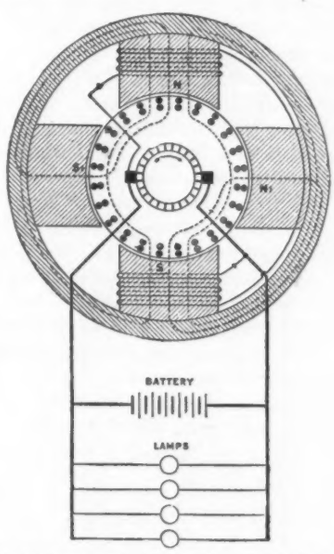


Fig. 1—Diagram of Automobile Lighting System.

possible by the redistribution of the flux between the wound and unwound poles as the demagnetization comes into play. A typical output curve of one of these generators, showing the exceptional steadiness of the current over a wide range of speed, is shown in Fig. 2. While any standard winding may be used for the armature, in the present case use is made of a

special winding in which the coils cover an arc of 120 deg. instead of the usual 180 deg. in a two-pole machine. The generators are made to give an e.m.f. of from 6 volts to 12 volts, and a fixed output of 5 amp, the generators of smaller output being intended for taxicabs. From the output curve of the generator it will be noticed that the generator begins to charge the battery at a speed of 600 r.p.m., and at all speeds above 1800 r.p.m. it gives a practically constant output. This machine is

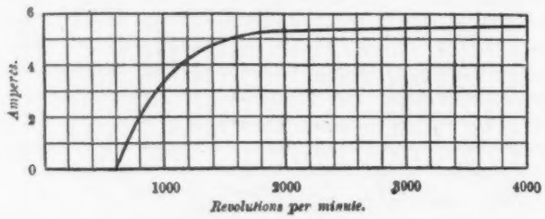


Fig. 2—Output Curve.

intended to be geared so as to run at from 1.5 to 2.0 times the speed of the engine.—Lond. *Electrician,* Sept. 23.

Enclosed Arc Lamp.—A note on a recent British patent (13,728, Sept. 15, 1910) of F. W. Schuer. All the parts of the lamp in communication with the inner globe are hermetically sealed, with the exception of a long, narrow outlet of 1/16-in. bore for the release of the generated gases. Entrance of oxygen into the globe is prevented and the combustion of the electrodes is reduced.—Lond. *Elec. Eng'ing,* Sept. 22.

Support for Metallic-Filament Lamp.—A note on a recent British patent (6397, Sept, 22, 1910) of the Wolfram Lampen A.-G. A spring support allowing for vibration in all directions consists of a carbon-filament fixed at one end to the central stem, and provided with a hook or loop for holding the metal filament at the other end. A large loop or coil in the center of the arm gives the desired elasticity.—Lond. *Elec. Eng'ing,* Sept. 29.

Generation, Transmission and Distribution.

Water-Power in Sweden.—An abstract of a recent report of the Swedish water-power committee. The total water-power in Sweden is estimated to amount to 10,000,000 hp capable of being utilized for from six to nine months in the year and 2,500,000 hp which can also be used during the period of low level of the water. Out of the total quantity 75 per cent is to be found in north Sweden, 15 per cent in the Province of Svealand and 10 per cent in Goetaland. The total which will be in use in the near future will be 600,000 hp, of which 340,000 hp will be for the production of electric energy. At present the State is considered to own 880,000 hp, of which 670,000 hp can be employed without any previous regulation of the waterfalls concerned, but the State now utilizes only 63,000 hp, of which 40,000 hp is in the station at the Trollhattan Falls, although work is in progress there for the use of an additional 40,000 hp. It is proposed to erect a 50,000-hp generating station at the Porjus Falls, in north Sweden, capable of being extended to twice this size, while the State also contemplates large generating stations near Akarleby, in Dalarne, and in other localities. Being exceptionally interested in the use of water-power the State has pursued a systematic waterfall policy since the adoption of the law concerning the Trollhattan Falls, although great difficulties have to be contended with owing to the antiquated laws respecting the right of disposal of water-powers. It is probable, however, that a new law on modern principles will be proposed in the near future, and the water-power commission has already prepared a scheme for this purpose. The State has comprehensive projects now under consideration. Preparations are now being made for the regulation of the large Wanern Lake and the Siljan Lake, but, above all, plans are being considered for the utilization of the water-powers of the middle and southern portions of the country in connection with the electrical operation of railways, and the State has acquired waterfalls in these districts for the sum of over $1,250,000. In case the electric frontier railway in the north meets expectations, it is said that the other State railways will eventually be converted to electric traction.—Lond. *Elec. Review,* Sept. 30.

Electric Driving in Textile Mills.—L. Crouch.—The conclusion of his illustrated paper, the chief results of which are as follows: The chief advantages of the electrical driving of textile machinery are: (1) some 20 per cent diminution in breakages, owing to the smoother driving torque; (2) 10 per cent to 20 per cent increase in output per hp-hour with an improved quality of output (at least 5 per cent increase in value); (3) superior efficiency. If the millwriting involved by mechanical drive is straightforward, the initial efficiency is about equal to that of the equivalent electrical drive, but if many changes of direction (and hence bevel gears, etc.) are involved the electrical system has the advantage from the first. Owing to the ease with which power measurements may be made, and to the reduced number of bearings and length of shafting, the efficiency of electrically driven mills can be permanently maintained at practically maximum efficiency, whereas a mechanical system inevitably soon deteriorates considerably. Electrical driving benefits from many years' experience of millwrighting and a ready selection can be made of the best. Only the best must be used, and the whole plant must be kept in perfect order to reap the full benefits of electrical operation. Reciprocally, only the latter enables such maintenance to be carried out. Electrical driving has involved several slight changes in textile millwrighting and machinery design, the most noticeable of which are: (1) The speeding up of line shafting to suit it for direct coupling to standard electric motors; (2) the speeding up of the machine shafts (for example, the tin roller shaft of ring-doubling frames) for the same reason. This naturally involves a greater speed reduction in the machine itself, though, owing to steadier driving, a slightly greater running speed is permissible at the work if electric driving be adopted. The finer the "count" handled and the higher the quality of the material the greater and more desirable are such abstract advantages of electrical operation as the enhanced cleanliness due to the absence of most of the ropes and belts otherwise required, and the freedom from the dust created and stirred by the same.—Lond. *Elec. Review,* Sept. 30.

French Water-Works Plant.—A. Turpain.—A detailed and profusely illustrated description of the Tuiliere water-power plant in the southwest of France. It has a total rating of 24,000 kw, of which 18,000 kw is derived from water-power and 6000 kw from steam. The steam plant is used chiefly as reserve. The generating voltage is 1500 and the transmission voltage partly 13,500 and partly 50,000.—*La Revue Elec.,* Sept. 15 and 30.

Electric Haulage in Mines.—An article illustrated by diagrams describing the different systems of hauling in coal mines and pointing out the advantages of electric hauling. Whether three-phase or direct current is to be used will in general depend on the electric system available; but when a new installation is to be put down direct current is preferable.—Lond. *Elec. Review,* Sept. 30.

Traction.

Frequency for Alternating-Current Traction.—W. Wittek.—The author gives a review of the evolution of single-phase traction for main railroads and thinks that it is due to some unnatural phases of this evolution that the frequency of twenty-five, which was originally favored, has come into disfavor, so that a frequency of fifteen is now often preferred. The author thinks that this is wrong and that the matter should be taken up systematically, and that an endeavor should be made to standardize also the maximum voltage on the trolley wire. The increase of the latter from the usual 10,000 volts to 15,000 volts certainly seems quite feasible.—*Elek. u. Masch.* (Vienna), Sept. 18.

Brake Shoes.—J. W. Dawson.—A paper read before the (British) Municipal Tramways Conference in which the author described investigations which had been undertaken with the object of ascertaining the comparative durability of the various grades of brake shoes used on tramcars in England, together

with their wearing effect upon steel tires. Twenty different grades of shoes were tested. Figures were given of the wearing properties of shoes and tires run under ordinary service conditions, and the results showed that the individual shoes of each group vary considerably in durability. The rate of wear of soft gray-iron shoes is more uniform than that of other groups, and the most excessive wear is obtained with white iron. Similar large variations were found in the wearing effect upon tires. The author advocated a microscopical analysis, in addition to chemical analysis and physical tests, so that the particular structures producing the different characteristics of the shoes might be indicated and a standard specification drawn up. In the author's opinion, it matters little from the point of view of cost which suffers most, the shoe or the tire. When it is desirable to economize energy for brake application and to reduce mechanical stress upon brake gear to a minimum, it is best to use a shoe with a high coefficient of friction. In the discussion which followed the possibility of evolving a standard specification for brake shoes was questioned.—The paper in full in Lond. *Electrician*, Sept. 30; abstracted in Lond. *Elec. Eng'ing*, Sept. 29.

Tramways in Relation to Town Planning.—A. BAKER.—An abstract of a paper presented before the (British) Municipal Tramways Conference. The paper was a plea for the construction of roads sufficiently wide to carry a double line of tramways in the center and roadways for ordinary traffic on either side. It was suggested that, instead of developing tramways outward from the center of the city, property several miles out should be "town planned," and the roads built toward the big city. With such roadways the author would considerably cheapen the cost of tramway construction, either by the use of macadam paving, which would be worn out by ordinary traffic, or by leaving the space between the rails filled in with turf. Incidentally, the paper condemned the trolley omnibus system, the author believing it the best policy to lay down tramways in the first place, and if necessary face a loss for a year or two. The paper was severely criticised by a large number of speakers, principally on the cost of land mentioned by Mr. Baker and his condemnation of the trackless trolley system.—The paper in full in Lond. *Electrician*, Sept. 30; abstracted in Lond. *Elec. Eng'ing*, Sept. 29.

Lubrication of Car Bearings.—An abstract of a report presented to the (British) Municipal Tramways Conference prepared by E. Cross, R. L. Acland, P. J. Pringle and T. R. Smith. The committee have found that oil is most in favor, and that out of fifty-six tramway undertakings only seven use grease. From replies received from all the tramway undertakings in the United Kingdom it is found that the cost of oil varies from 11 cents to 50 cents per gallon, and, indeed, this large variation has manifested itself throughout. So startling are these variations that the committee is unable to account for them. At Rotherham the motors are run 51,000 miles for 1/16-in. wear on the armature bearings, while at Bournemouth the corresponding figure is 3000 miles, and at Aberdeen and Blackpool about 5000; at Belfast the suspension bearings last for 27,000 miles, while at Burton-on-Trent they lasted only 5300; at Lincoln the axle bearings have run 106,500 miles, at Darwen 350,000, at Liverpool 5000 and Manchester 3600. It is recommended that a system of ring lubrication or its equivalent should be insisted upon in all new motors, as excellent experience has been obtained in a few undertakings that have had these motors installed for a sufficient time to give a decided opinion. With the ring system the waste of oil is practically nil, and, consequently, a higher grade of oil can be used without excessive cost. A better supervision of the work of the "greaser" than is generally the case was insisted upon.—The report in full in Lond. *Electrician*, Sept. 30; abstracted in Lond. *Elec. Eng'ing*, Sept. 29.

Municipal Tramways in Great Britain.—A. S. FLINT.—A paper read before the (British) Municipal Tramways Association on the first ten years of municipal tramway working in Great Britain. At the present time there are in Great Britain 176 tramways owned by municipalities, only eighty-four of which, however, are worked by the same authority that owns them. Concerning the latter, the following information is given:

	1899		1909
No. of undertakings	6		84
Miles of track	52		2,422
o. of cars	197		7,986
No. of miles run	3,374,806		197,938,433
No. of passengers	38,432,470		1,933,118,206

The invested capital was $3,486,350 in 1899 and $202,181,750 in 1909. In nearly all the towns which show a deficit either the energy cost is high or they have a small population. Towns with separate generating stations show better results than those with combined stations, that is, where tramway committees have to buy their energy.—Lond. *Electrician*, Sept. 23.

Mountain Railway.—F. NIETHAMMER.—An illustrated description of the Bernina Railway, which is the highest adhesion railway in Europe, and connects St. Maurice (1778 m, or 5832 ft., above sea level), in Switzerland, with Tirano (429 m, or 1407 ft., above sea level), where connection is made with the Veltellina three-phase railway. Energy is supplied to the Bernina Railway from the Brusio hydroelectric works, the first plant of which contains twelve generating sets of 3000 kva, while a second plant is soon to be started. The Bernina Railway is operated by direct current at 750 volts on the trolley wire, the alternating current being transformed to direct current in four substations.—*Elek. u. Masch.* (Vienna), Sept. 4 and 11.

Paris.—C. JACQUIN.—An article, with a map and diagrams, on the Metropolitan Railway of Paris describing especially lines opened in recent years and giving a review of the different substations which convert the three-phase currents received from the generating plants into direct current at 1550 volts for supply to the third rail.—*La Revue Elec.*, Sept. 30.

Installations, Systems and Appliances.

Graphical Methods for Calculating the Cost of Operation.—H. GIESI.—The energy consumed by any machine is partly consumed in making up the losses and partly in producing the useful work. A diagram may be plotted with the useful work as abscissa and the consumed energy as ordinate; the curves of this diagram are in general straight lines for all kinds of machines, for instance, the Diesel engine, and for the steam turbine. In the latter case there is found $y = ax + b$, where y is the consumption of steam in kilograms per hour, x the load in kilowatts, a a figure which depends on the steam pressure and the superheat, while b is the steam consumption at no load, including excitation in kilograms per kw-hour. The total cost of operation is the sum of fixed charges and variable charges. Of the variable charges a part is proportional to the useful work produced, while the balance (due to the losses) is proportional to the time of operation. If diagrams are plotted with the total cost of operation per unit of useful work as ordinate and with the yearly energy quantities as abscissas, the curves obtained are hyperbolas. The diagram is simplified when the reciprocal values of the yearly quantities of energy are used as ordinates, the curves then being straight lines.—*Zeit. d. Ver. Deutsch. Ing.*, vol. 53, No. 48, page 1968; abstracted in *Elek. Zeit.*, Sept. 22.

Wires, Wiring and Conduits.

Calculation of Transmission Lines.—J. BARTOK.—The calculation of the electrical conditions in long transmission lines leads to complicated formulas containing trigonometric and exponential functions. The author starts from the formulas given in a book of Roesslear and shows how the complicated functions can be developed into series. In this way he arrives at simpler approximate formulas which are sufficiently accurate for practical requirements so as to find directly the voltage and current at the end of the line and also to determine the cross-section. The article is illustrated by diagrams and by numerical examples.—*Elek. u. Masch.* (Vienna), Sept. 25.

Cable Works.—An illustrated description of Rickard's cable works at Derby, giving some details of the method of rubber covering of wires and the braiding machines.—Lond. *Elec. Eng'ing*, Sept. 29.

Electrophysics and Magnetism.

Positive Electricity.—J. J. Thomson.—A lecture held before the British Association giving a further account of his experiments on "positive rays" in discharge tubes. In these continued studies he had found that the investigations became simpler and more definite when he worked with very large tubes or bulbs. For when the vacuum tube was small the negative dark space near the cathode extended up to the wall, and the discharge might crack the glass. With large tubes the pressure of the gas in the bulb could be reduced much lower, and the dark space could attain large dimensions before reaching the glass wall. He had used bulbs holding 11 liters, but had found tubes of 2 liters, such as applied in boiling-point determinations, sufficiently large, as a rule. A fine tube extended backward from the cathode, through which the rays (positive or canal) passed on to the willemite screen. The screen which formed the one end of the bulb was flat and circular, and the general arrangement was as in his previous experiments, the positive rays passing through an electric field and through one or two electromagnetic fields on to the screen. The potential difference between the electrodes and the gas pressure was varied, and the bulb was charged with different gases. When neither field was excited the positive rays would produce a bright spot in the center of the screen. The electric field would deflect and draw out the spot into a horizontal band, while the magnetic field would draw it into a vertical band; when both fields were turned on together, an inclined band of positive rays would be seen, and sometimes also a backward continuation of this band due to negative rays. The inclination of the band would indicate the velocity of the particles. By altering the order of the fields and their strengths and lengths, sharp-angled or curved bands were obtained. In very large tubes, at high exhaustion, the positive band would become faint, and would be replaced by bright spots, which occupied different positions in different gases. The position of these spots would change with the potential difference, and when several gases were in the bulb the different patches were arranged in the same vertical. The patches were not really circular, but parabolical arcs curved upward. Negative bands corresponded to some of these patches, but not to all, and in the case of hydrogen two spots were noticed, one near the origin, in the same vertical as the others, the other further out. In explanation of these phenomena Sir J. J. Thomson suggested that the following types of radiation could be distinguished: (1) Rays not deflected either by electric or magnetic force. (2) Secondary rays produced by rays (1); these were deflected by electric and magnetic forces, and had a constant velocity of about 2×10^9 cm per second, the velocity being independent of the potential difference (varied between 3000 volts and 30,000 volts) and of the gas pressure; the ratio $e \div m$ also had the constant value 10^4. This value had been supposed to be greater than the normal—namely, 1.5×10^4; that point should be investigated in every possible way. (3) Rays characteristic of the gases in the bulb and conspicuous only at low gas pressure. Their velocity depended on the potential difference, and when several gases were present (hydrogen, helium, air, for example), the maximum kinetic energy of the rays corresponding to each of the gases was the same, and seemed to be that due to a fall through the potential difference between the negative glow and the cathode. The values of $e \div m$ for the different gases were inversely proportional to the atomic weights. Thus these rays were probably atoms of the gas carrying unit charges, and in the case of hydrogen there seemed to be rays corresponding both to the atom and to the molecule. In the cases of mercury-vapor, air and the hydrogen atom, the negative bands were also visible; in the cases of the hydrogen molecule and the atoms of helium, carbon and neon the negative constituent had not been detected. There was a considerable range in the velocities of the rays from the same gas, but at low gas pressure most of the particles seemed to move at nearly the maximum velocity. The rays corresponding to the different atoms could be separated by deflecting them with the aid of the magnetic and electric fields. Each kind of ray produced a kind of spectrum under the simultaneous action of the two fields. (4) The fourth type of rays was the one he had formerly called "retrograde" rays. They traveled from the cathode in the same direction as the cathode rays. They had negative constituents, and seemed to be of types (1) and (2); rays (3) had not, so far, been detected among them.—Lond. *Engineering*, Sept. 23.

Number of Electrons in an Atom.—J. A. Crowther.—A paper read before the British Association on experiments made with beta rays to determine the number of electrons in an atom. The chief conclusions are that the positive electrification in an atom occupies a volume comparable with that of the atom, and that the number of electrons in the atom is three times the atomic weight of the substance.—Lond. *Eng'ing*, Sept. 23.

Magnetic Properties of Iron Alloys.—The Reichsantalt investigations have been continued on the chemical composition and treatment of iron alloys and their effect on the magnetic and electric properties. When the last traces of hydrogen were removed from electrolytic iron by heating in vacuo it was possible to reduce the originally high coercive force to such a degree that it has become more feasible to produce iron absolutely free from hysteresis. With one and the same sample of very pure iron it was possible to produce at will any form of hysteresis curve by varying the treatment of the sample (probably meaning the heat treatment). Permeability and remanence of the same sample of iron could be changed at will to a certain degree.—*Elek. Zeit.*, Sept. 22.

Electrochemistry and Batteries.

Electric Steel Plant.—J. W. Richards.—A profusely illustrated description of the Lindenberg steel works in Remscheid, in Germany, where Héroult electric furnaces have been in operation for several years with good success. The steel supplied to the electric furnace is taken from an open-hearth furnace. Two electric furnaces are used, one of 1.8-ton and the other of 3.6-ton rating. The power used by the 1.8-ton furnace is 250 kw and the specific energy consumption 385 kw-hours per ton of fluid metal treated; the 3-ton furnace takes power of 350 kw and as low a value of energy as 235 kw-hours per ton of steel treated. Of the 350 kw it requires 250 to keep the furnace up to a constant temperature, while the other 100 kw (about 30 per cent) is used in melting the fluxes which are added and in raising the temperature of the bath. The electric refining process is described in detail. The manufacturers state, on the basis of five years' experience, that the electric steel is more nearly of the desired composition, more uniform in composition, and can be made from far cheaper raw materials; that the cost is far less for the smelting operation, far less for labor; that the labor required is much easier and safer, the output per given sized plant is greater, the steel is more free from blow-holes, develops fewer edge-cracks or surface faults, and for a greater ductility will carry more carbon and, therefore, show higher strength.—*Met. and Chem. Eng'ing*, October.

Rubbing Powders for Nickel and Zinc Plating.—A description of a new plating process of A. Rosenberg. A wet rag is dipped into the plating powder mixture and then rubbed on the surface to be coated. The principle is that if this surface is metallic, or at least electrically conducting, electrolytic action is set up in the wet mixture which is rubbed on and the desired metal is deposited on the surface. A suitable powder mixture for nickel plating contains 60 parts of nickel ammonium sulphate, 3 parts of metallic magnesium, 30 parts of chalk, 7 parts of talc powder. For plating zinc on iron or copper a powder of the following composition may be used: 45 parts commercial zinc dust, 15 ammonium sulphate, 3 magnesium, 30 chalk and 7 talc powder. The magnesium particles are coated with a very thin wax layer to protect them against oxidation.—*Met. and Chem. Eng'ing*, October.

Electrolytic Chlorine.—B. du Faur.—A paper on the plant for producing chlorine by electrolysis of brine at Mount Morgan, Queensland, Australia. Use is made of a diaphragm cell with a diaphragm of asbestos cloth. The method of purifying the electrolyte before supplying it to the cell is described in great detail and the evil effects of the presence of caustic soda in anode liquor are discussed and data are given on salt con-

sumption, energy consumption and efficiency.—*Met. and Chem. Eng'ing,* October.

Electric Laboratory Furnace.—D. F. CALHANE.—An illustrated description of a convenient and quite inexpensive electric laboratory furnace for very high temperatures. It is a resistance furnace with a carbon resistor.—*Met. and Chem. Eng'ing,* October.

Units, Measurements and Instruments.

Standard Cells.—E. COHEN.—A paper read before the German Bunsen Society. The Weston cadmium cell without an excess of solid crystals of cadmium sulphate is not considered to be a standard cell in the proper sense, since deviations of the e.m.f. from the standard value are then possible, even if the cadmium amalgam fulfils all the requirements, as stated below. Cadmium amalgam containing 12.5 per cent by weight is unsuitable for standard cells which are to be used in the temperature interval from 0 deg. C. to 40 deg. C. But a 12.5 per cent amalgam would be suitable in the interval from 14 deg. C. to 60 deg. C. An 8 per cent cadmium amalgam is suitable for cadmium standard cells in the interval between -4 deg. C. to $+40$ deg. C. An exact temperature formula for the e.m.f. of the cadmium cell has not yet been given. The formula proposed by the International Conference on Electric Units and Standards in 1908 does not represent the facts and should be replaced by another formula based on measurements of standard cells containing an 8 per cent amalgam. The previous history of the cadmium amalgam used in the standard cell has a decided influence on the e.m.f. With an 8 per cent amalgam it is possible to construct a portable standard cell.—*Phys. Zeit.,* Oct. 1.

Flat-Coil Galvanometer.—E. F. NORTHRUP.—A Franklin Institute paper in which he first makes a few general remarks upon galvanometer design, then describes a basis upon which the merits of different galvanometers may be compared in certain of their prominent features. $\left(\frac{S_m}{T^2\sqrt{R}}\right)$ is the usual expression for the figure of merit of any galvanometer where S_m = sensibility, T = period and R = coil resistance. In comparing galvanometers by it the supposition is made that thickness of insulation is neglected and that the galvanometers compared are wound with wire of the same specific resistance. The specifi-

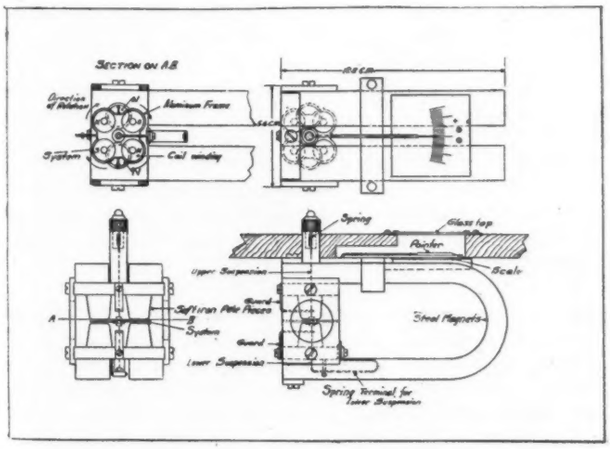


Fig. 3—Diagram of Flat-Coil Galvanometer.

cation which the author adopts to define S_m is as follows: With the scale at 1000 scale-divisions from the mirror of a mirror galvanometer, the sensibility S_m is the number of megohms which must be in the galvanometer circuit so that with an e.m.f. of 1 volt in the circuit there will result a deflection of one scale division. F is the figure of merit and the unit of it is called a D'Arson. A galvanometer would have, then, a unit figure of merit if its time of a complete oscillation is one second (or, which is practically the same thing, if its time of aperiodic return to the zero within one-twentieth per cent of its previous deflection is one second) and the resistance of its winding is 1 ohm, and when, with 1 megohm in series and 1 volt in circuit, its deflection on a scale one-thousand scale-divisions from its mirror is one division. Every consideration shows that in starting out to design a galvanometer of any type which is to have a large number of D'Arsons one should begin by carefully considering the selection of the mirror, pointer or other contrivance essential to reading the deflections, so that this contrivance may have the least possible moment of inertia; for it is the mass of these "dead parts" which ultimately sets a limit to the maximum figure of merit obtainable. In the second part of the paper the author describes a flat-coil galvanometer which is a radical modification of the D'Arsonval type of moving-coil galvanometer. The construction of a pointer-portable instrument of this type is shown in Fig. 3, which is self-explanatory. The following are the main advantages of the construction. When current energizes the four disk-like coils they all contribute to produce rotation in the same direction. A reversal of the direction of the current reverses the direction of rotation, the deflections, with equal current, being the same to either side of the zero. As the galvanometer has no iron core, there are only two air-gaps, one above and one below the coil, instead of four as required by the D'Arsonval galvanometer with an iron core. In the second place all of the magnetic field is active at all times in producing a turning moment regardless of the angular position of the system. Thirdly, the aluminum form in which the four coils are held serves admirably as a magnetic damper. Further, if the instrument is to serve as a ballistic galvanometer its moment of inertia can be made very great out of material which is active in producing a turning moment, and for such service the construction is ideal. Some rules are given of the best proportioning of the parts of this instrument, and finally a table is added giving comparisons between sixteen galvanometers of different kinds and by different makers.—*Jour. Franklin Inst.,* October.

Electric Measurement of High Mechanical Pressures.—At the Reichsanstalt an electric method of measuring high pressures has been investigated. It is based on the fact that the resistance of a wire wound on a tube is increased after the tube is acted upon by a high pressure from the inside so as to expand it radially. The measurement of the resistance must be very exact while the accuracy with which the pressure is found is only moderate. The practical value of the method is, therefore, doubtful.—*Elek. Zeit.,* Sept. 22.

Meters.—In the report of the Reichsanstalt a review is given of progress made in meter construction. It is pointed out that the weight and the price of meters is now only from one-fourth to one-half of what it was ten years ago, but it is thought that further progress can be made by more carefully designing the counting devices.—*Elek. Zeit.,* Sept. 22.

Telegraphy, Telephony and Signals.

Efficiency of Wireless-Telegraph Installations.—W. H. ECCLES AND A. J. MAKOWER.—The Telefunken Gesellschaft claims to reach in a normal plant an effeiency of 75 per cent, and the Lepel Wireless Syndicate claims to get higher than 60 per cent. The authors have found with an apparatus which was not precisely the same as that of these two firms, but was rather of an intermediate nature, an efficiency of less than 50 per cent. This efficiency is that of transference of oscillatory energy from the circuit containing the discharge-gap to the aerial wires. The authors have studied the method used by the Telefunken company in their efficiency measurements, which is indirect and rests upon one that is widely applied in the determination of the logarithmic decrements of vibratory circuits. The present authors show experimentally that the method is not exact and may lead to values of the efficiency which are too large. It seems that the proportional waste in the gap increases as the aerial resistance decreases.—Lond. *Electrician,* Sept. 30.

Wireless Telegraphy.—A note on a recent British patent (20,230, Sept. 22, 1910) of G. Marconi and the Marconi Wireless Telegraph Company, Limited. Aerials are made directive by arranging the antennae horizontally in a vertical plane passing through the stations. The antenna is brought very close to the ground, and to avoid the loss in efficiency due to the high resistance of the surface of the ground underneath wires are buried or laid at the surface underneath the antenna.—Lond. *Elec. Eng'ing.* Sept. 29.

Book Reviews

Direct and Alternating-Current Testing. By Frederick Bedel. New York: D. Van Nostrand. 265 pages, illus. Price, $2.

Many faults supposed to be inherent in laboratory manuals are conspicuous by their absence in the present treatise. Professor Bedell has evidently chosen his experiments for their real instructive and practical value rather than for the purpose of utilizing a given laboratory equipment. Not only are the tests well chosen, but the method of presenting them is excellent. The tests are not described in detail, to do which would usually merely fill up space with things that all who use the book would know; but the purpose of the test, the reasons for using certain methods, the value and limitations of various methods, etc., are discussed, thereby encouraging the reader to think and work intelligently instead of blindly as is usually the case with students working from a laboratory manual. A general idea of the scope of the work may be had from the following outline: Direct-current generators; direct-current motors; synchronous generators; single-phase currents; transformers; polyphase currents; phase changers; potential regulators, etc.

The Design and Construction of Induction Coils. By A. Frederick Collins. New York: Munn & Company. 272 pages, 155 illus. Price, $3.

The induction coil is no longer confined to laboratory work, but is designed and built to do definite work under specified conditions. The design of induction coils has been almost entirely empirical because of the number of variables which occur in each individual case. Mr. Collins has treated the design in a purely empirical fashion. He gives directions in detail for building a style of coil suited to wireless and laboratory service. The explanation of the theory of operation of an induction coil is comparatively simple, yet the reader will find himself more confused than enlightened after perusing the theoretical part of this book. To illustrate the author's rather peculiar way of saying things, the following statements are quoted: ". . . An electric current flowing in a conductor is partially changed into magnetic lines . . . "; ". . . the expansion and contraction of the magnetic lines . . . will cause the lines of force to impinge upon the turns of the coil itself and in this way accentuate the e.m.f. of the current flowing through it"; "a current can only flow when there is an e.m.f. sufficient to overcome the resistance of the circuit." The unfortunate part of the whole thing is that these loose statements occur in the theoretical portion of the book. If the student is to get a clear grasp of the subject it must be clearly and truthfully stated and extreme attention paid to the correct use of terms. There are many important statements made which, if not erroneous, are at least very misleading. For instance, the statement is made that increasing the iron-core section will allow the magnetizing force to build up faster. This might easily be construed to mean that the current growth or decay in a circuit is accelerated by increasing the inductance. This "mix-up" is probably due to a loose usage of magnetizing force for flux, and is sure to tangle a student and make it hard for him to follow the discussion.

In several places the author emphasizes the fact that the secondary voltage depends upon the ratio of the primary to secondary turns. Practice and theory will show that there is no fundamental relation between voltage ratio and turns ratio as in transformers. In the induction coil the secondary voltage depends upon the number of secondary turns, the flux in the core when the primary circuit is broken and the speed at which the flux disappears. The flux depends on the primary amp-turns and the speed of flux decrease is determined by the interruption, the capacity across the break and the constants of the primary circuit. The time appears ripe for a thorough-going treatise on the design of induction coils.

Steam Tables: Tables and Diagrams of the Thermal Properties of Superheated Steam. By L. S. Marks and H. N. Davis. New York: Longmans, Green & Company. 106 pages. Price, $1.

In these days of steam turbines, supreheated steam locomobile units and gas turbines a modern book of superheated steam data, such as the above, is a most useful contribution to engineering literature. As is well known, the tables which have appeared up to the present have been based upon the classic investigations of Regnault of more than half a century ago. During recent times the work of scientific investigators has yielded new values of the total heat of dry steam, both above and below atmospheric pressure, determined with an accuracy hardly possible in Regnault's day. It is upon these later determinations that the present tables have been based.

Table I gives the pressure, specific volume, density, latent heat, total heat, internal energy and entropy of saturated steam for every degree Fahrenheit from 32 deg. up to 400 deg, and thence by tens up to 689 deg., the critical temperature. Table II gives pressures of saturated steam from 1 lb. absolute up to 600 lb. Table III gives the properties of superheated steam, advancing by 10 deg. from 10 deg. superheat up to 200 deg., and by 50 deg. from 200 deg. up to 600 deg.; and for pressures from 1 lb. up to 250 lb., then in 5-lb. steps up to 400 lb., and thence to 600 lb. in 50-lb. steps. The properties given are for water and saturated steam, temperature in degrees Fahrenheit, specific volume in cubic feet per pound, total heat units from water at 32 deg. and entropy from water at 32 deg. As the highest working temperatures at present necessary in compound engines with double superheat range about 587 deg. Fahr., this table amply covers the practical range, running as it does up to 1086 deg. total temperature of the steam. For special investigations Table IV gives the increase in total heat and in entropy for steam superheated above 600 deg. plus the temperature of the saturated steam—as it may well become in gas turbines. It covers pressures up to 600 lb. and superheat at these pressures up to 2000 deg. Fahr.

Part II of the book is devoted to two graphical diagrams and an explanation of their use. Diagram I is a total heat entropy diagram, known as the "Mollier diagram," for saturated and superheated steam, and is primarily for use in the solution of problems involving adiabatic expansion, throttling and the flow of steam. Diagram II is a total heat-pressure diagram for saturated and superheated steam, showing specific volumes, superheats and properties, and is primarily for use in problems involving ratios of expansion. Both diagrams are large and clear, about 18 in. x 24 in., and contained in a separate pocket in the book and may be mounted on cardboard for handy use on the draughting table.

Part III of the book contains a discussion of the sources from which the tables were derived, a matter which would be naturally inquired into by serious investigators before accepting the tables as a basis for their work.

The Life Story of Sir Charles Tilston Bright. By Charles Bright, F. R. S. E. Revised and abridged. London: Archibald Constable & Company. 478 pages, 68 illus. Price, $4.50.

This volume is an abridgment and revision of a larger work with the same title written by the author and his uncle, which was reviewed in these columns in the issue dated Sept. 9, 1899; and it shows in every page the appreciation of an affectionate son for the achievements of a distinguished father.

That Charles Bright was among the leading engineers of his country and day is seen from the confidence placed in him by capitalists, from the inventions which he patented and from the successful way in which were met the new and formidable difficulties that arose in the memorable enterprise of uniting telegraphically the Old World with the New.

Though Bright was not a graduate of a technical institution, nor even an ex-apprentice to an engineering firm, he was chosen at the early age of twenty-four to fill the place of engineer-in-chief to the first expedition (1857) that undertook to lay a cable on the bed of the Atlantic. It was fortunate for the

electrical side of the enterprise that another young man was connected with it; for in Professor Thomson (Lord Kelvin), though only in his thirty-third year, the official electricians had a resourceful adviser, while the board of directors of the Atlantic Telegraph Company had a "tower of scientific strength."

The difficulties encountered in the expeditions of 1857 and 1858 in the cable tanks, at the paying-out machinery and in the electrical testing room; the anxieties of exasperating frequency; the mishaps that occurred and the warring of the elements are all told in 135 pages in a manner that makes exciting and instructive reading even at the present day.

The congratulatory message of Queen Victoria to President Buchanan is given on page 157, and if it had been added that the 100 words there printed took 16½ hours in transmission and only 67 minutes in retransmission for verification, the reader would have realized at once the unsatisfactory character of the Whitehouse receiving apparatus at Newfoundland compared with the reliable, fast-working mirror galvanometer of Thomson which was used at Valentia.

The dogged conservatism of Mr. Whitehouse which led him —the company's chief electrician—to retain the unsuitable apparatus at the American end of the line ultimately proved fatal to the cable. To overcome the growing difficulty of signaling across, Mr. Whitehouse gradually increased the battery power at Valentia until the number of Daniell cells used was nearly 500; and when this proved insufficient, the unwise official had recourse to the great penetrative energy of induction coils, which gave the ill-fated cable its *coup de grâce* after barely a month's existence.

Mr. Cromwell Varley, who succeeded Mr. Whitehouse (retired), admitted that the faulty condition of the cable "was no doubt due to the employment of induction coils;" and Professor Hughes declared that the cable "was injured by the induction coils and that the intense currents developed by them were strong enough to burst through gutta percha." On the other hand, Professor Thomson said that "with a properly adjusted mirror galvanometer at each end twenty cells of Daniell's battery would have done the work required."

In this connection it may be recalled that Latimer Clark, using a silver thimble, a pencil of zinc and a few drops of dilute sulphuric acid, was able to send clear signals from Valentia through the two cables of 1865 and 1866 joined together at Newfoundland, a distance of 2700 miles. Mr. Bright relates this interesting fact on page 193, but does not add that signals were sent from Newfoundland to Valentia with a smaller cell consisting of a *gun-cap*, a needle of zinc and a drop of dilute acid. This was also a noteworthy telegraphic feat. Though the author makes thirteen allusions to Mr. Cyrus W. Field, he nowhere waxes warm over the man or his achievements. He does say in the text on page 38 that Mr. Field was "a man of sanguine temperament and intense business energy," and in a footnote on the same page he adds that Sir Charles Bright described Mr. Field as "rapid in thinking and acting, and endowed with courage and perseverance under difficulties."

It is only fair to say that to the above personal qualities there are many who would add that throughout the enterprise Mr. Field was the guiding spirit of the company. The following resolution of the board of directors shows no ordinary degree of appreciation:

"*Resolved*, that the warm and hearty thanks of the company be tendered to Mr. Cyrus W. Field, of New York, for the great services he has rendered to the Atlantic Telegraph Company by his untiring zeal, energy and devotedness from its first formation and for the great personal talent which he has ever displayed and exerted to the utmost in the advancement of its interests."

Hon. John Mullaly, of New York—the historian of the enterprise—is referred to three times on page 139, but the name of the book, "The Ocean Telegraph" (329 pages), from which the quotations are taken is not given, nor is it said that Mr. Mullaly was on the *Niagara* in 1857 as secretary to Professor Morse and in 1858 as secretary to Mr. Field, and that on both occasions he was the correspondent of the *New York Herald*. This might have been stated, inasmuch as considerable prominence is given to Mr. Nicholas Wood, who was on the *Agamemnon* as reporter for the London *Times*.

Scant justice—to say the least—is done Mr. W. E. Everett, chief engineer in the United States Navy, whose services were secured for the company from our government by Mr. Field; for, if we read page 77 rightly, the paying-out machinery that *laid* the cable was "devised, adopted and constructed" while Everett was in America. It should be said that Everett was on the *Niagara* in 1857 as chief engineer and that after the unsuccessful attempt of that year he returned home for a while, but was back in London in 1858 for the purpose of making the necessary preparations for his share in the submergence of the cable in the following summer.

The claim made on page 77 is anything but confirmed by the following letter, under date of April 24, 1858, from Mr. George Saward, secretary of the company, to Mr. Everett:

"As you have now reported to the managing committee that the paying-out machinery for H. M. Ship *Agamemnon* is completed and that it has been working satisfactorily during the last three days and that you do not consider any alterations necessary to increase its efficiency, and as another set is required for the United States frigate *Niagara*, the managing committee have authorized and instructed me to request that you will immediately give directions to Messrs. Easton & Amor to put another set in hand for that ship; and I am further to request that you will continue your supervision over the construction of the machinery and also undertake to superintend and direct its being properly fixed and fitted on board the *Niagara*.

"I am further instructed to request that you will take charge of the operation of experimenting upon and subsequently of paying out the cable from that ship, in doing which you will have the co-operation of Messrs. Woodhouse, Follansbee and of such assistant engineers as you may consider it requisite to appropriate to such service. You are also authorized to make such preparations and arrangements as are necessary to enable you to carry out the foregoing instructions."

Besides making it evident that the paying-out machinery for both ships was constructed under the superintendence of Mr. Everett, it also shows that he was not simply the ship's engineer, as our author says, but that he was in the full sense of the term "chief engineer" on board the *Niagara* when the cable was laid in 1858.

Other chapters of this interesting book give the history of the great "telegraph to India" line, which was completed in 1864 by the cable from Fao, at the head of the Persian Gulf, to Karachee, the sea terminus of existing lines; the deep-sea Malta-Alexandria cable, 1868, and the West India network, 1870.

These and similar expeditions, which made great demands on the mental activities of Sir Charles Bright, kept him so much away from home that there was but little leisure left for the domestic circle or for social life. The strain of professional duties and the effects and exposure to malignant climatic influences told severely on a system that was never over-strong, and, at the age of fifty-six, brought a life so bright with promise and so full of achievement to a close on May 3, 1888.

Bright's closeness to work is shown by his motto, *Nulla dies sine linea*. Like his lifelong friend, Lord Kelvin, he always carried with him a notebook to jot down thoughts as they occurred, to sketch pieces of apparatus or to solve problems connected with work in hand.

The chapter on "Home Life and Recreations" contains fifteen pages; we regret that there are not many more, for it is in unprofessional hours and when the cares of the day are over that are best exhibited the qualities of mind, heart and will which go to make up the true man.

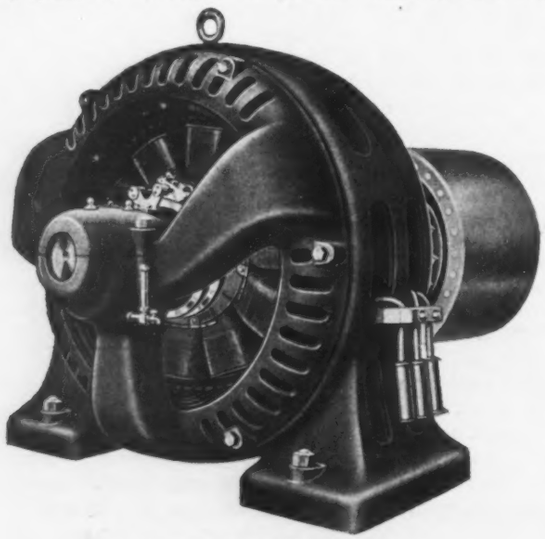
To all connected with ocean telegraphy in its various aspects the life of Sir Charles Bright contains valuable information; to the general reader it will prove an inspiration, showing how difficulties can be overcome and triumphs achieved by energy and perseverance.

New Apparatus and Appliances

REVOLVING FIELD ALTERNATOR.

In a line of revolving-field type alternators recently placed on the market by the Triumph Electric Company, Cincinnati, Ohio, special attention has been paid to the ventilation of all parts.

The usual standard ratings at 35 deg. C. and 40 deg. C. temperature rise have been adopted, the machine being furnished for either rating according to the duty it has to perform. Generally speaking, a 40 deg. C. temperature rise is considered better for machines which have to carry a non-inductive load, while a machine which has to carry an inductive load, such as arc lamps or induction motors, would be better when rated on the 35 deg. C. basis.



Revolving Field Alternator.

The regulation of the alternators is said to be in accordance with the best engineering practice, and varies from 6 per cent on a machine with a 35 deg. C. rise to 8 per cent on a machine rated at 40 deg. C. temperature rise. The use of a relatively large amount of copper in both the rotor and stator windings has kept the copper loss low. Moreover, the core losses are comparatively low, and it is claimed that the machines have exceedingly high efficiencies.

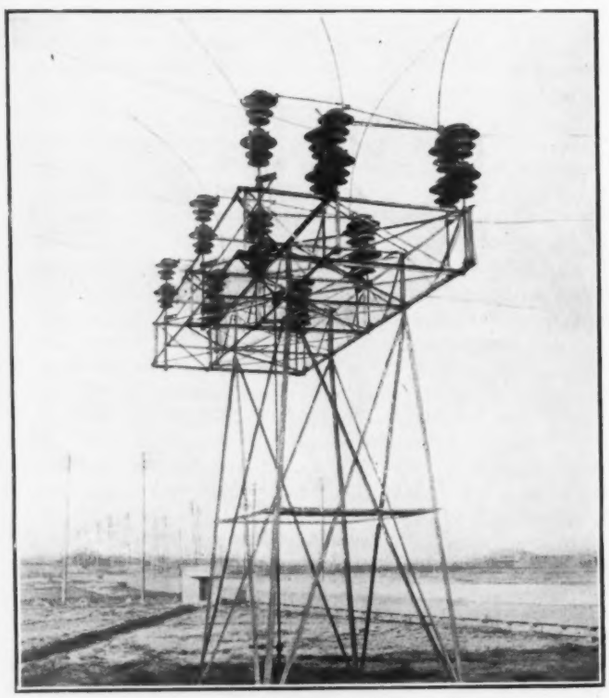
TEST OF A 104,000-VOLT SWITCH.

At the Bay Shore substation of the Sierra & San Francisco Power Company is installed a "Kilarc" type L switch, built by the Bowie Switch Company, through which passes one of the incoming lines of the Stanislaus Power Company, which supplies the United Railroads of San Francisco with power. The system is operated at 104,000 volts, the highest pressure at present in commercial use. This switch was built to handle at least 10,000 kw and to open under load. The operating parts for breaking the load are similar in principle to those of the standard type K switch built by the same company. By the direction of motion of the blade the arc is first drawn upward, away from the insulators, thereby avoiding any possibility of the heat of the arc affecting the insulators.

This switch has been in service for over the last three months, and is situated in a location particularly severe on insulators owing to the salt fogs, high winds and dust, and the insulators have not been cleaned since it was installed.

To determine the ability of the switch to open under load a test was recently made by loading the line with an inductive load of 52 amp on the high-tension side, or over 9000 kva. The switch handled the load without the slightest difficulty, and opened without causing any voltage disturbance to the system, other than would occur from the change of current. There was practically no surge on the line, and the pressure at the power house was raised only 3500 volts, or about 3 per cent maximum when the switch was opened. This demonstrated conclusively that no material rise of voltage accompanies the opening of this type of horn switch.

This is a subject which has caused considerable discussion by engineers, as some have maintained that the opening of air switches would set up serious oscillations in the line. This opinion is without doubt due to the use of air switches of improper design, where the break in the arc occurs in an arc which is ascending in nearly a vertical direction, and where the rupture of the arc will occur in such a manner that the ascending column of heated air will cause the arc to re-form. It is claimed that in horn switches of the type shown it is a practical impossibility for the arc to break in such a manner,



104,000-Volt, 10,000-Kw Switch.

since the tendency for the arc to rise is so strong that with proper inclination of the horns the break will be substantially horizontal, and in such a manner that there is no possibility of the arc re-forming, and hence there will be no surging. The result of extended experience with these switches is stated to have shown that they will operate without causing material disturbance of voltage, and in this respect are considerably superior to oil switches, owing to the high resistance of the long arc, which greatly weakens the current before the final break.

This test was particularly severe owing to the highly inductive load, which tended strongly to maintain the arc and to have the stored magnetic energy kick back on the line. Judging by the manner in which the switch operated, without doubt its actual capacity is far in excess of the rating. The photograph shows a view of the switch, which is mounted on a structural steel framework, thoroughly braced, and mounted on a steel tower.

PORTABLE MOTOR-DRIVEN VACUUM CLEANER.

The B. F. Sturtevant Company, of Hyde Park, Mass., has applied its experience in the manufacture of air-moving machinery to the vacuum-cleaner problem and has designed a special fan for which, after two years of experiment and observation, it now claims many distinct advantages. The fan operates at 3400 r.p.m. and is said to give a vacuum that draws in a very large volume of air at a pressure insufficient to injure the fabric of the carpet or other material being cleaned. The air is drawn in at a high velocity, so that the machine takes up large

Fig. 1—Portable Motor-Driven Vacuum Cleaner, Showing Dust Receptacle.

particles of matter. The cleaner has no valves, diaphragms, pistons, connecting rods or eccentrics, the apparatus consisting simply of a case containing the fan, which is mounted directly on the armature shaft. The motor is of standard design and

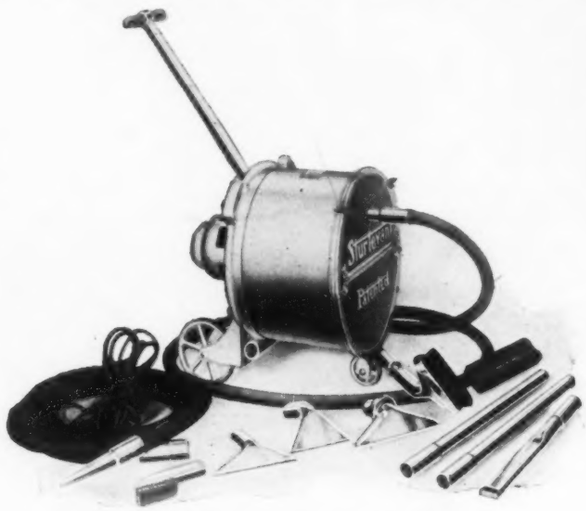


Fig. 2—Portable Cleaner and Cleaning Tools.

is provided with ball bearings packed in lubricant. Direct-current, alternating-current or universal motors are obtainable, and there are only two wiring connections, a snap switch controlling the motor. A dust bag of unusually ample proportions is introduced in front of the fan, the large screen area preventing undue reduction of air velocity. The cleaner is mounted on three rubber-covered wheels, and provided with a detachable handle. It weighs 50 lb. and requires a space 2 ft. by 2 ft. A full complement of cleaning tools is provided with each machine, many of these being of new design developed by the company, and all of them having been tested in service under various conditions.

THE FIELD ELECTRIC OMNIBUS.

After years of development work Mr. C. J. Field, who in years past has been prominently identified with the Edison central-station interests and the building of electric railways in a number of the large Eastern cities, including Buffalo, Philadelphia, Worcester, Bridgeport, Newark and other places, has completed and tried out at the Edison Works in Orange, N. J., his first electric omnibus operated with the Edison storage batteries.

During the past few months this publication has given several accounts of the results being secured with the Edison battery and the wide commercial development which is taking place with this battery for trolley car work, truck work and pleasure automobiles. The latest application of the battery is to large omnibuses for use by public-service companies.

The Field omnibus, seating thirty passengers, is built to operate on public roads without tracks, and will have a radius of travel on one charge of half a day's service, equal to fifty to seventy-five miles, depending on roads, grades, service, etc. This car, as shown by the illustration, is 22 ft. long over all, by 7 ft. 4 in. wide, and has a wheel base of 13 ft. 6 in. The body without platforms is 17 ft. in length, has cross seats of regulation length of 33 in., with 19-in. wire spring, rattan seats and backs. The total weight of the car is under 8000 lb., of which

Fig. 1—Electric Omnibus—City Type.

20 per cent is in Edison storage batteries. The motor equipment consists of two motors of 7 hp each, trolley car rating. The drive from the motors is direct with Morse silent chains to sprockets on the rear wheels in the ratio of 15 to 71, with 0.9-in. pitch. The front and rear wheels are 34 in. to 36 in. diameter, equipped with a 4-in. single and 4-in. dual solid rubber tires respectively, with Timken roller bearings for city type, and floating bronze bushings for interurban type. The wheel construction is amply strong to meet all requirements for severe service. The axles are imported nickel chrome steel forgings having a tensile strength of 130,000 lb. per sq. in. The springs, made by Lemoine of France, of the very finest mangano silicon steel, are half elliptic with nine leaves in the front and eleven in the rear, and are practically flat under load. Two-thirds of the load above the springs is carried by the rear and one-third by the front springs.

The frame of the chassis is of ash strips 1¼ in. by 5 in. faced inside and out with ¼-in. by 5-in. cold-rolled strip steel, the cross members being rolled channels. The fittings for the springs are all riveted to this frame, to which the body is directly attached.

The Electric Omnibus & Truck Company, 135 Broadway, New York City, and Passaic, N. J., is building the buses, the city type being shown in the photograph. Interurban type buses to operate without a conductor have the same carrying capacity, and smaller type buses will be built later. There is no experimental feature in connection with these cars, every part or feature in connection with them having been proved and tried under service conditions. The omnibuses were designed by C. J. Field and Raymond Cilley, engineers of the company, with the additional benefit of Mr. Edison's inspection and suggestions. There is a wide field for the application of vehicles of the type shown.

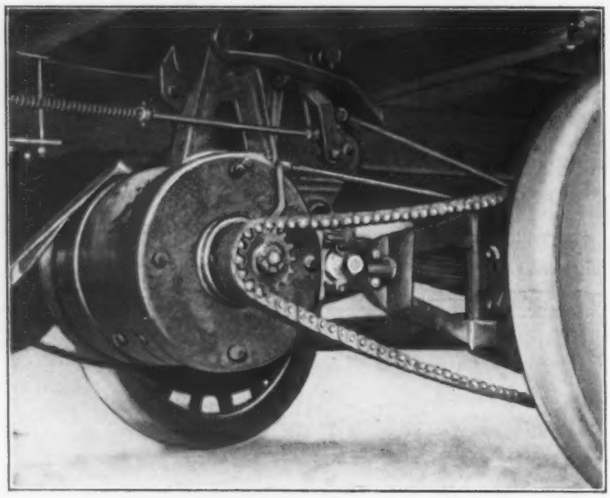


Fig. 2—Electric Omnibus—Details of Motor Drive.

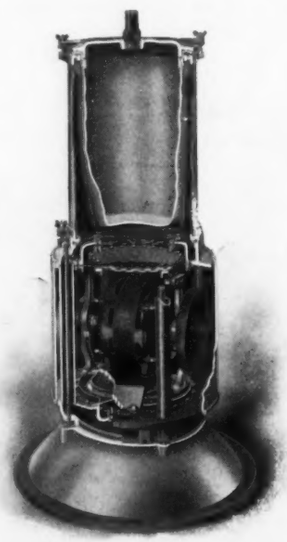
INTERIOR ILLUMINATED ELECTRIC SIGN.

The Flexlume Sign Company, Limited, of St. Catharines, Ontario, Canada, and Buffalo, N. Y., manufactures an interior illuminated electric sign which makes an excellent appearance by day or by night. The letters are of prismatic glass in bold relief. The prisms on the under side of the glass are said to represent so many mirrors and to sparkle in the reflected sunlight. Each letter is illuminated by one lamp, and carefully designed reflectors give a powerful and even distribution of the light through the raised glass characters. The letters are so arranged that they can be swung out from the face of the sign so as to provide access to the lamps, reflectors, etc. The signs are made entirely of metal, and all of the wiring, lamps, etc., are completely protected from the weather. The signs are outlined with raised rope moldings and ornaments finished in gold leaf, and the letters are trimmed with gold. At present the letters are manufactured in different sizes, ranging from 6 in. to 24 in. inclusive. The signs are adapted for all classes of work, and are particularly effective for interiors. The letters are quite legible and are easily read from sharp angles. The sign, as shown in the accompanying engraving, does not possess the earmarks of the ordinary electric sign.

Interior Illuminated Electric Sign.

STATIONARY DUPLEX VACUUM CLEANER.

The Keller Manufacturing Company, of Philadelphia, Pa., has brought out a one-sweeper duplex stationary vacuum cleaner, a sectional view of which is shown herewith. There are but five moving parts in the device. Gears, cranks, levers and chains are dispensed with, straight-line construction being provided. The machine weighs 180 lb., has a base 23 in. in diameter and stands 40 in. high. It is equipped with a ¼-hp motor, and is said to exhaust 40 cu. ft. of air and to yield a vacuum ranging from 8 in. to 9 in. at an expenditure of power not exceeding 325 watts. The motor is supported midway between the operating parts and in a straight line with them, and owing to the peculiar construction of the machine, whereby the load is balanced, the wear on the motor bearings is said to be uniform, being as much on the top as on the bottom surface of the bearings. Large oil cups using special grease are provided, so that operation can go on for several months without any attention being given to the machine. The special pump units are the same as those employed in the familiar "Santo" portable electric vacuum cleaner. A 1½-in. inlet connects the machine through a hose with the house piping, and the lid or cover of the dust chamber is held in place by two thumbscrews. Solid-rubber gaskets set in grooves in the lid and ring around the top of the dust chamber casing minimize leakage, and the ring supporting the dust bag rests between these two rubber gaskets. The dust bag is made of special closely woven cotton drilling, and an emergency bag made of heavy felt completely surrounds the dust bag and prevents dust or dirt getting into the operating parts should the operator carelessly put the lid on without placing the dust bag in its receptacle. A perforated steel plate covers the pump chamber and supports the dust bags. A rubber gasket forms a seal between the bottom ring of the dust chamber and the upper pump casting. The motor and pump compartments are surrounded by galvanized-steel casing and an upper aluminum connecting link is attached to the eccentric on the motor shaft and the moving portion of the upper pump. Two flywheels are fitted to the motor shaft and a cast-iron straddle bracket supports the motor midway between the upper and lower pumps. The machine is almost noiseless in operation, and it is claimed will operate without attention for long periods under conditions encountered in ordinary household work.



Stationary Duplex Vacuum Cleaner.

ELECTROLYTIC LIGHTNING ARRESTERS.

Many devices have been placed on the market for the protection of electric equipment from abnormal voltage on the line, but the electrolytic lightning arrester, which consists of nested aluminum trays filled with electroyte and submerged in oil, has ideal characteristics for this purpose, in fact, resembles in action a relief or safety valve. The horn-gaps which are between the arresters and the line break down on over-voltage, and if this voltage amounts to over approximately 330 volts per tray a free passage through the film from tray to tray and thence to the ground is provided. When the voltage drops to normal, which is below the critical voltage of the tray, the apparent resistance of the film reasserts itself and the flow of the current is cut down so that the horn-gaps disrupt the arc and all further flow of current ceases.

The nested trays are placed in oil-filled, welded-steel tanks, which for 22,000 volts and above are built with cast covers and outdoor terminals, so that the entire arrester can be placed outdoors. The complete arrester consists of four tanks mounted on an insulated platform for ungrounded neutral service, and three tanks grounded for grounded neutral service. For 13,200 volts and under the arrester is arranged for indoor service only, as the horn-gap setting is so small that much more effective service is obtained when the arrester is housed. For the lower voltages the general arrangement of trays is the same, but a smaller number of tanks is used.

Since when the electrolytic type of arrester is allowed to stand without current passing through it the film on the plates dissolves, it is necessary periodically to pass current through the arrester in order to keep the film in the best condition.

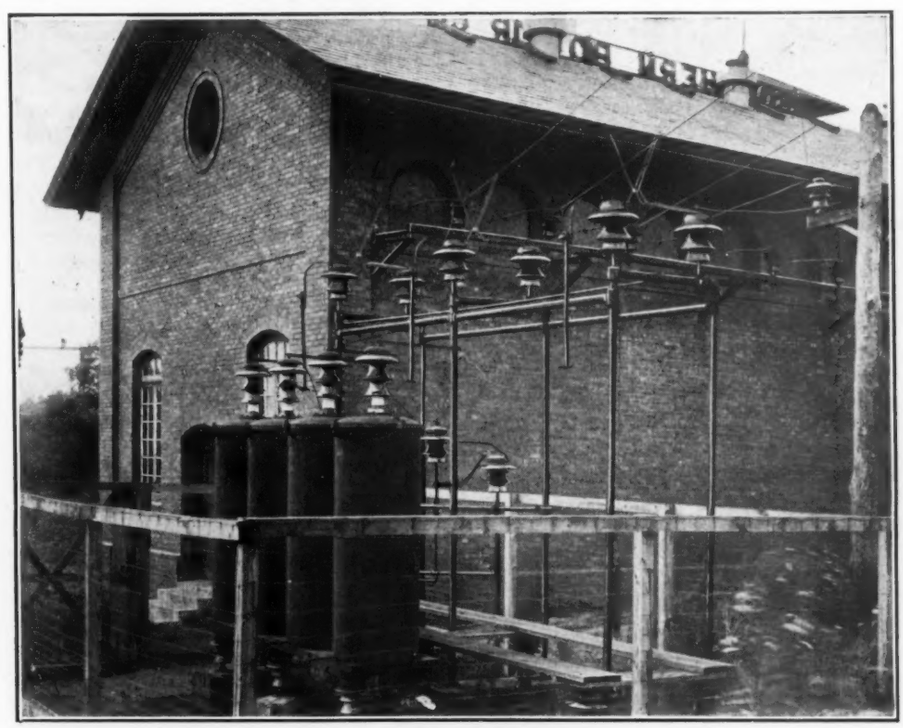


Fig. 1—Electrolytic Lightning Arresters at Entrance to Station.

This prevents an abnormal rush of current when the arrester discharges after a long period of idleness.

The rate of dissolution of the film depends upon the kind of electrolyte used and the temperature. There are two kinds of electrolyte made by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., one which requires that the horns be bridged daily to pass current through the arresters, and the other that the horns be bridged only every seventh day. The latter electrolyte has been known to stand without current for very long periods during cold weather, and when the horns were bridged no undue rush of current followed. However, in order to keep the films well built up it is recommended that current be passed through this electrolyte every seventh day; this offers no inconvenience, as apparatus in general should be inspected at least this often.

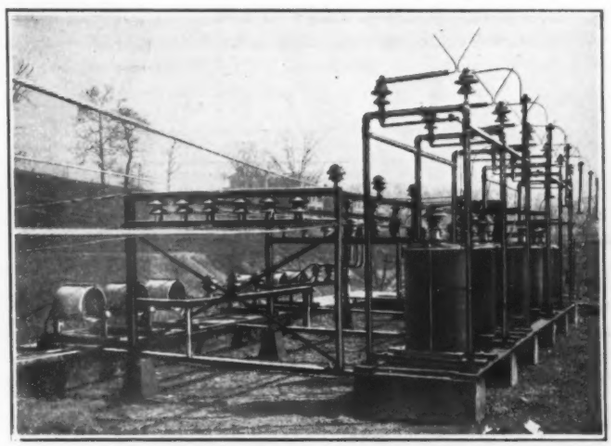


Fig. 2—Two Sets of Electrolytic Lightning Arresters, Showing Choke Coils and Line Connections.

When arresters are bridged at normal voltage a bluish, crackling static arc indicates the normal condition of the arrester. If the arc is reddish and fluffy, and rises high on the horns, it is evident that the bridging of the horns has been deferred too long a time, and it will take a short period before the arc comes down to normal.

The horn-gaps and bridging device are mounted on a 2-in. pipe frame, to which is also attached the transfer switch used for interchanging a ground and phase tank on underground neutral arresters. The bridging device is very simple and can be operated from either end.

As the voltage increases the number of trays in the arrester also increases. Hence, for a higher voltage, if the trays were all built in a continuous structure, it would be very awkward to handle and require considerable overhead room when installed indoors. For this reason, on all arresters above 13,200 volts, the Westinghouse tray structure is built up into sections containing not over fifty trays, which slide into place, one above the other, between guides supported by a base casting fitting closely to the bottom of the tank. Each section when filled with electrolyte can be easily handled without danger of upsetting it. The electrolyte is poured into the trays by means of a measuring cup, which contains the correct amount of liquid for each tray. When a section of trays is filled the electrolyte is plainly visible so that each tray can be checked.

All parts of the supporting frame directly in contact with the trays are made of the best grade of porcelain; hence, any danger due to burning supports, which is likely to be present in case wood is used, is entirely eliminated.

If, when the horn-gaps are set to get the maximum protection from the arrester, a ground on one phase occurs, the horn-gaps connected to the other phases will discharge until the line is cleared, or if thus subjected to a continuous discharge that may last a long time, the Westinghouse arresters are designed with large tanks holding sufficient oil to absorb the heat of a continuous discharge lasting over a considerable period. The tanks are built large enough on the diameter so that the clearance between the top tray and tank where the maximum voltage exists provides a good insulation factor of safety.

VARIABLE-FIELD SPEED-CONTROLLING SYSTEM FOR DRIVING NEWSPAPER PRESSES.

There was placed on the market recently an electric motor installation for driving printing presses for which numerous advantages are claimed by the makers.

A prominent feature of the system is the special arrangement of control stations. There are press-buttons performing three different functions; these buttons may be designated as "A," "B" and "C." The "A" button is a device for starting the motor and increasing its speed. It is equipped with a safety device for locking the press against any further increase in speed until released at the station at which it was applied, but allowing it to be slowed down to 10 r.p.m. of the cylinders or to be stopped from any station while the press is at "safety." The "B" button is for decreasing the speed of the press from maximum to 10 r.p.m. of the cylinders. The "C" button is for stopping and locking the press simultaneously and holding it locked until the locking device has been released at the station at which it was applied.

In the event of any disarrangement of the wires of the press control station the equipment may be operated either from the head pressman's control station or by hand. An emergency button is provided on the board for rapid stopping in connection with the hand control.

The system is said to be "foolproof." Should more than one pressman push the "slow-down" button the equipment would slow down. Should one pressman push the speed button while another simultaneously pushed the "slow-down" button the press would slow down at once. Pressing the "stop" button not only stops the press, but locks it at every station until the automatic catch on the stop button is released at the station where it was applied; thus it is safe for any pressman, by merely stopping the press, to go under it without danger.

The motor used with the equipment is of the commutating-pole type designed especially for printing-press work and hence developing heavy torque at starting. The motor and its two pedestal bearings are mounted on a substantial bedplate which is machined for the alignment required with gear drives.

The equipment described above has been placed on the market by the Garwood Electric Company, Garwood, N. J.

SNAKING AND FISHING MACHINE.

The Conduit Machine Company, 225 Fifth Avenue, New York, has brought out a snaking and fishing machine intended to reduce the labor of fishing and wire pulling to a fraction of its present cost. The machine shown in Fig. 1 is designed for fishing ½-in. conduits and can be used for large loft or office-building work. It weighs 50 lb., and in operation is conveniently placed at any outlet. The snake is coiled on the lower reel and from there is led into a conduit box, where it is held between two wheels which bite about 2½ in. of the snake. Before the fishing wire starts these wheels are clamped together and the snake is forced through the conduit into a small flexible shaft. The flexible shaft is usually about 12 ft. long, and 2 ft. or 3 ft. of it can be threaded into the outlet. The speed at which the snake can be forced through the conduit depends entirely upon the operator. When obstructions or hard bends are met with the fish wire is grasped near the outlet and rammed back and forth until the bend is passed. It is seldom, however, that ramming will be called for, since the motion of the snake is continuous and the momentum forces it around any bends which are fished with difficulty by hand. For instance, in hand-fishing when a hard bend is reached the operator must work against the friction of the snake on the side of the conduit

Fig. 1—Snaking and Fishing Machine for Conduits in Buildings.

throughout its entire length, and also overcome the inertia of the snake throughout its length before he can apply the full force at its head. With the machine shown when the end of the snake appears at the outlet it is only necessary to attach the duplex wire, unclamp the wheels, place the crank lever on the lower wheel and by cranking draw the wire through the outlet into the conduit. The manufacturer claims that it is a very easy matter to pass two or three boxes where the snake comes through direct, and to cut the duplex wire after it has gone

Fig. 2—Heavy Machine for Use in Street Conduits and Mains.

through. The machine shown in Fig. 2 is designed for fishing terra-cotta, street conduits and large mains. The laborious task of screwing together small sections of snake, requiring considerable time, is avoided by the use of the machine in question. The manufacturer claims that when operated by hand it is possible to fish 500 ft. of conduit in two minutes and 100 ft. of lateral in about twenty-eight seconds.

Industrial and Commercial News

The Week in Trade.

WHILE commercial authorities profess to discern a better feeling or undertone to the condition of trade during the past week, there is little evidence of any increase in actual business. The widespread tendency toward conservatism in purchases is still to be noted and the policy of placing small and frequent orders rather than risking any large buying seems to be the prevailing one among the retailers. The most encouraging feature of the week was the confirmation by government statistical authorities of the optimistic trade estimates of the principal crop yields. Both the corn and oat crops will be bumpers and the wheat yield will be larger than had at first been calculated. There continues to be evidence that stocks of cotton and woolen goods in retailers' hands are very light, but high and uncertain prices are serving to contract purchases. The unusually high price for raw cotton is also doing much to embarrass the manufacturers. In the iron and steel industry the volume of orders being placed is unusually light. The report of the United States Steel Corporation, showing the amount of orders on hand at the end of September to be almost the lightest in the history of the organization, reflects also the condition of the independent mills. The demand for structural material has been greatly reduced with the advance of the fall season and there is practically no buying by the railroads for bridge construction. The car works, too, are remaining out of the market, and appear to be hopeful of securing better prices. The agricultural sections of the country give much more evidence of prosperity than those dependent upon the industries, and in these collections are far better than they have been at any time during the year. Failures for the week ended Oct. 13, as reported by *Bradstreet's*, were 223 as compared with 192 the previous week, 220 in the same week of 1909, 244 in 1908, 194 in 1907 and 170 in 1906.

The Copper Market.

VERY much more life was exhibited in the copper market last week than during any similar period since last spring. Foreign buyers were in the market to a considerable extent, and according to the reports made by the selling agencies purchases for export were very liberal. One authority has made public the estimate that within two days 75,000,000 lb. of copper were sold to domestic consumers and foreign dealers. Handlers abroad seem more anxious to buy than the melters at home. The result of this movement was an advance in the selling price of all grades of copper by the producers, which in turn, of course, had a checking effect upon the buying enthusiasm. The majority of the transactions recorded last week were for November-December delivery, and quite a number of them extended into next year. As far as deliveries for the month of October are concerned it is not at all unlikely that they will show a decline. As deliveries, both domestic and foreign, represent the buying of from thirty to sixty days in advance the present movement will not affect the monthly statistics. It is believed, however, that the steps taken two months ago to curtail production will be reflected in the next report, and that therefore the surplus stocks on hand will show a marked decrease. During the past week lake copper was sold in this market at 12.87½, and electrolytic sold as high as 12.77½. It is claimed that toward the close of the week these prices were slightly shaded, but the bulk of the trading was done around the top figures. Imports of copper have been falling off for some time, and were inconsiderable during the past week. Exports, as stated above, are not running as heavy as during September. For the month up to and including Oct. 17, exports were 10,157 tons. The daily call on the Metal Exchange Oct. 17 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.40	12.60	.....
October	12.40	12.60	12.50
November	12.42½	12.62½	12.52½
December	12.47½	12.62½	12.55
January	12.52½	12.72½	12.62½

The London market Oct. 17 was as follows:

	Noon.	Closing.
	£ s d	£ s d
Standard copper, spot	57 7 6	57 8 9
Standard copper, futures	58 3 9	58 6 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	11.70c
London, spot	£62 0 0	£52 15 0
London, futures	65 18 9	53 7 6
Best selected	65 10 0	57 15 0

Industrial and Commercial Notes.

American Power & Light Company.—At a recent meeting of the stockholders of the Hanford Irrigation & Power Company, control of which has passed into the hands of the American Power & Light Company, as published in our issue of Sept. 22, a new board of directors was elected, and the following officers were subsequently chosen: Michael Earles, president; Judge C. H. Hanford and H. M. Walthew, vice-presidents, and G. F. Nevins, secretary and treasurer. The board of directors includes Guy W. Talbot, of Portland, Ore., vice-president and manager of the Pacific Power & Light Company, a subsidiary of the American Power & Light Company; William Jones, of Tacoma, Wash.; Henry Carstens, of Seattle; Gerald Frink and E. S. McCord. At the office of the American Power & Light Company it is stated that the reports published in the West concerning the organization of a large holding company which would engineer extensive developments at Priest Rapids on the Columbia River probably refer to the organization some months ago of the Pacific Power & Light Company. It is estimated that it is possible to develop at this point 300,000 hp. Only a small portion of these water rights are now controlled by the American Power & Light Company, and for the present only a moderate improvement of the Hanford plant is contemplated. Almost the entire business of this company is pumping water for irrigation purposes, although it also serves one or two small towns with energy for lighting.

Westinghouse Electric & Manufacturing Company.—It was stated last week that the New York, New Haven & Hartford Railroad Company had made a contract with the Westinghouse Electric & Manufacturing Company for the electrification of the Hoosac Tunnel, plans for which were referred to in the issue of Sept. 22. It is announced that the work will be started at once, and it is expected to have the road in readiness for operation in the early spring. The general plans of electrification are uniform with those adopted for the main line of the New Haven road. The length of the electrification work is about seven miles, including the four and three-quarters mile tunnel with the approaches. The contract involves about $1,000,000. The Westinghouse company reports at the present time that it is well supplied with orders, and is employing about 19,000 workmen. This is an increase of 9000 over the number employed one year ago. The present rate of orders is running about $3,000,000 a month, or about 50 per cent increase over October, 1909.

Mt. Hood Railway & Power Company.—The Mt. Hood Railway & Power Company, Portland Ore., which did considerable construction work some two years ago, has made necessary arrangements for rapid completion of the construction. The complete project involves three power plants of a combined capacity of 66,000 hp and 25 miles of electric suburban railway. The construction now under way includes the railway running eastward from Portland and the first power development of 16,000 hp. It is expected to deliver power in Portland next August, as a considerable amount of construction and machinery manufacturing has already been done. The engineers for the company, Smith, Kerry & Chace, have assembled at Portland a designing staff from their various offices, W. P. Brereton being in charge of designing, and J. B. Goodwin, formerly of the Niagara Falls Power Company and McCall Ferry Power Company, as superintendent of construction.

Westinghouse Turbines for Brazil.—The Rio de Janeiro Light & Power Company has just ordered from the Westinghouse Electric & Manufacturing Company two 2500-kw Westinghouse-Parsons steam turbines, together with a complete equipment of Le Blanc condensers, circulating pumps, etc. The equipment will be installed in a new station in the city of Rio de Janeiro to work in connection with the company's hydraulic plant forty-five miles distant.

Calgary (Alberta) Power Company.—The Calgary Power Company, Ltd., has had under construction in the past year a plant of 19,500-hp capacity on the Bow River, 50 miles west of Calgary. The works consist of a concrete dam 70 ft. high and 400 ft. long, hydraulically operated steel sluice gates for flood control, four penstocks of 250 ft. length, two being 9 ft. 6 in. in diameter and 2 12 ft. in diameter. The operating head will be about 75 ft. Three units are now being installed, two of 2500 kw each, furnished by the Canadian General Electric Company, and two turbines of 3750 hp each, furnished by the Canadian Brown-Boveri Company. The third and fourth machines are of 4000 kw each, with turbines of 6000 hp capacity. One of these units has been ordered, the generator being furnished by the Canadian General Electric Company, the turbine by the Wellman-Seaver-Morgan Company. Energy will be generated at 12,000 volts and transmitted at 55,000 volts. The complete transforming and switching equipment for generating station and Calgary terminal station is being furnished by the Canadian Westinghouse Company, the transformers being three-phase units of 3000 kw each, three being installed in each station. Additional to this there are a 12,000-volt, double-circuit transmission line and a substation of 3000 hp capacity to supply the Exshaw Cement Company with power. The power company also has contracts to supply the Canada Cement Company's mill at Calgary, and the City of Calgary is taking a block of 4000 hp for the operation of the street railway, commercial lighting and general power business. It is expected that the plant will be in operation during the coming winter. The engineers for the company are Smith, Kerry & Chace, and the officers are H. S. Holt, Montreal, president; R. B. Bennett, Calgary, vice-president; C. B. Smith, Toronto and Calgary, managing director.

I. P. Frink.—The reflector manufacturing firm of I. P. Frink has moved into its new factory and offices at 239-243 Tenth Avenue, New York. The concern purchased the property on the corner of Tenth Avenue and Twenty-fourth Street, remodeled the building and has now a first-class plant equal to its needs. The business of the firm had outgrown its rather contracted quarters on Pearl Street, where it had been in operation for more than 50 years. In the new quarters it will be provided with elaborate showrooms for its lighting effects and dark rooms for testing lamps. The firm has recently taken quite a number of large contracts for installing lighting systems, among which are those for the new High School at Wilkes-Barre, Pa.; the Automobile Club of America building, of New York City; American National Bank, of Richmond, Va.; Duquesne National Bank, Pittsburgh, Pa.; Bloomingdales' department store, New York City, in which entirely new fixtures have been installed; Brill Brothers' new store on Broadway, which is being advertised as the best-lighted store in the metropolis; Buckley, Newhall & Company's department store on 125th Street; St. Alphonsus' Church and the new Union Theological Seminary, both in New York.

Colorado & Wyoming Telegraph Company.—The Mountain Telegraph Company, of Denver, which operated about 1300 miles of lines jointly in the interests of the Colorado Fuel & Iron Company and the Victor-American Fuel Company, has been reorganized. The Mountain Telegraph Company will retain about 350 miles of these lines along the Colorado & Southern Railroad, which will be managed as an independent organization, J. R. Waltz having been appointed superintendent to succeed E. E. McClintock, who went to the Western Union Telegraph Company on Oct. 1. The Colorado & Wyoming Telegraph Company has been organized to take over the rest of these lines, and R. E. Fisher has been appointed superintendent. The new company will operate about 1000 miles of line, extending from Southern Colorado to the northern part of Wyoming, and to various mining camps and properties belonging to the Colorado Fuel & Iron Company.

Reliance Operating Company.—The Reliance Engineering Company, of Cincinnati, Ohio, which is general manager of the Spencer Light, Power, Heat & Water Company and the Indiana Electric Transmission Company, and which designs and builds complete industrial establishments, electric power plants and interurban traction roads, has formed a company called the "Reliance Operating Company," which will handle supplies of all kinds used by central stations. The company will be glad to receive from manufacturers catalogs and discounts.

Western Union Telegraph Meeting.—The annual meeting of the stockholders of the Western Union Telegraph Company was held last week, and all of the old board of directors were re-elected. The financial report of the company for the year which ended June 30, 1910, was published in our last issue. In his annual report President Robert C. Clowry said that, while the business of the company has shown a very satisfactory increase and the financial condition was now very encouraging, it had been thought best to continue the annual dividend at 3 per cent, because the directors considered that no change should be made until such reorganizations and improvements in the property shall be made as will enable better and extended facilities to be offered to the public. "To meet the growing demands of the plant and traffic," said Mr. Clowry, "the general superintendent of the first division, Belvidere Brooks, was appointed general manager, and the number of general divisions was increased from four to six. Greater authority has been given both to general and district superintendents, and many changes have been made which will increase the efficiency of the organization and promote the welfare of employees. It has not in the past been possible for this company to keep a large proportion of its offices open both day and night, Sundays and holidays, but under the arrangements which are now in operation in some sections of the country, and which will soon extend to all, it is expected that we will be able to maintain continuous telegraph and cable service twenty-four hours a day and every day in the year." Mr. Clowry said that the response of the public to the new night-letter service, which was introduced during the past year, had been very gratifying.

Western Electric Company.—The prospects now are that the Western Electric Company will be able to live up to its previous estimate of a gross business for the year of $61,000,000. September was a very satisfactory month, the total sales being an increase of 40 per cent over those of September, 1909. October, which is usually one of the largest fall months, has so far been well up to expectations, and will show a proportionate increase. The business is well distributed among the various departments of the company and is also well distributed territorially. There are now 24,000 employees on the company's pay roll, which is the largest number since 1906. The company's fiscal year ends Nov. 30. At a special meeting of the directors in Chicago last week an expenditure of $900,000 was authorized for the expansion of the Hawthorne plant. It is given out that this increase in capacity is needed to take care of the growing business.

General Electric Company Sales.—While the sales of the General Electric Company fell off slightly in September as compared with both August and July, they were still sufficiently large to warrant the belief that the year's business will amount to between $70,000,000 and $71,000,000. The July orders were approximately $6,000,000; those of August about $5,700,000, and those of September $5,600,000. A gratifying feature of the company's business during the current year has been the extremely narrow range within which the monthly records have fluctuated. Early in January the officials were inclined to estimate that the gross business for the year would reach $80,000,000. In the late spring this estimate was modified, as orders did not keep at the rate at which they started early in the year.

Monorail Railroad Approved.—The Public Service Commission of the First District of New York has granted permission to the Pelham Park Railway Company and the City Island Railroad Company to put into operation the newly constructed monorail line between Bartow Station, on the New York, New Haven & Hartford Railroad, and City Island. The permission is contingent upon making some minor track changes and rewinding the car motors as suggested by the commission's engineers. The commission also limits the speed of the cars to 15 miles an hour for the present. Severe tests were made in the presence of the commission's engineers and the road was pronounced safe.

MacGovern, Archer & Company.—MacGovern, Archer & Company have bought out the apparatus of several stations of the Edison Electric Illuminating Company of Boston. These stations are located at Alston, at which 4000-hp generators were installed; at Brookline, at Waltham and at Woburn. The lighting company will have substations using transformers at these points hereafter.

Sale of Western Electric Real Estate in Chicago.—The Pennsylvania Railroad Company has purchased from the Western Electric Company about five acres of land lying south of Polk Street and between the South Branch of the Chicago River and Stewart Avenue, in Chicago. It is said that the deal represents $1,800,000, the price of the land being $8 a square foot. The property will be used for an extension of the Pennsylvania's freight terminal. It has a frontage of 400 ft. on the Chicago River, and was used as the Polk Street works of the Western Electric Company, before the manufacturing operations of the company in Chicago were concentrated at the large Hawthorne plant.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Pittsburgh, Pa.; Annapolis, Md.; Paintsville, Ky.; Lakefield, Minn.; Bethany, W. Va.; Birmingham, Ala.; Libby, Mont.; Sandpoint, Idaho; Joliet, Ill.; Manhattan, Kan.; Interlochen, Mich.; Irwin, Pa.; Palisade, Col.; Cananea, Sonora, Mex.; Montreal, Que., Can.; Nashville, Tenn.; West Allis, Wis.; Prairie du Sac, Wis.; Newport, Ky.; Greenville, Tex.; Lewiston, Maine; Seattle, Wash.; Albia, N. Y.; Shelbyville, Tenn., and Clarion, Pa.

Columbia Gas & Electric Company.—The Columbia Gas & Electric Company, of Huntington, W. Va., has negotiated a deal whereby it will purchase the entire production of the Continental Oil & Gas Company, amounting to 15,000,000 cu. ft. daily. It is believed that this will eventually lead to the Continental company buying the output of all of the independent natural gas companies in the Guyandotte district.

U. S. Naval Academy Power Plant.—Supplementary specifications have been issued for the power-plant equipment of the U. S. Naval Academy, which introduce considerable changes in the original specifications, dated Aug. 17, 1910. A copy of the "Addenda" may be procured by application to the superintendent of the Naval Academy, Annapolis, Md., upon the deposit of $10. Bids are to be opened Nov. 12.

Westinghouse Turbo-Generators for Perth Amboy.—The Westinghouse Electric & Manufacturing Company has recently received an order from the Public Service Corporation, of New Jersey, for two 5000-kw, 13,200-volt, three-phase, 60-cycle, 1800-r.p.m. turbo-generators. These will be installed in the new power house of the Public Service Corporation at Perth Amboy, N. J.

Financial.

The Week in Wall Street.

OPINIONS are practically unanimous that last week was the most encouraging that Wall Street has experienced in the past five months. This is not due so much to the actual upward movement of prices—although this in itself was satisfactory—as to the general improvement in tone, the reawakening of interest and the birth of a sentiment akin to positive optimism with regard to the future. Although for the past three weeks there has been an evident buoyancy in the market, it was mainly demonstrated in the stubbornness with which prices refused to recede under the depressing tactics of the manipulators rather than by the definite advance of prices. It now seems that the market has been pretty thoroughly liquidated, and is in a condition where free buying may be expected. The selling had been in a measure overdone, and good dividend-paying stocks were quoted at prices much below their investment value. With the money market in the easy position it has maintained for many months, this could have been explained only by the far-extending lack of confidence. If the present upward movement means that confidence is being restored, we shall shortly have activity of trading and a fair bond market. As far as business is concerned, the latter is more to be desired than the former. Scores of industrial and transportation improvements are already planned, and are simply waiting for a favorable security market to be put into execution. When this time comes and the wheels begin to turn it will mean increased commercial business for the entire country. Every outside influence at the present time is in favor of an improvement in Wall Street. The political situation, while interesting, is in nowise disturbing; the financial condition is easy and business troubles are remarkably few, and the final returns from the crops are far better than had been anticipated earlier in the season. While there has been a slight advance in the rates charged by the banks for call money, terms are still very cheap. Quotations Oct. 17 were: Call, 2¾@3½; ninety days, 4¾@5 per cent. The quotations in the table are those of the close Oct. 17.

NEW YORK.

	Oct. 10.	Oct. 17.	Shares sold.		Oct. 10.	Oct. 17.	Shares sold.
All.-Ch.	10	11	400	Int-Met., pfd	56¾	59	37,140
All. Ch., pfd.	34	33½*	700	Mackay Cos.	96½	95¾	2,600
Amal. Cop...	66½	71⅞	82,500	Mackay C.,pf.	78¾	78¼*	520
Am. D. T....	20½*	20½*	———	Man. Elev...	145½	144	2,950
Am. Loc.....	37⅜	41⅛	3,900	Met. St. Ry..	15*	15*	———
Am. Loc.,pfd.	103*	105*	100	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am.Tel. & C.	85	87*	1,500	Steel, com....	70⅝	76⅞	609,725
Am. T. & T..	137⅝	139¼	7,105	Steel, pfd....	118½	120	7,980
B. R. T.....	76½	78⅛	21,750	W. U. T....	74½	73½	5,300
Gen. Elec....	151¼	154	4,700	West'h, com..	70	72	6,100
Int.-Met.	20⅝	22⅝	33,300	West'h, pfd...	125*	122*	500

PHILADELPHIA.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Am. Rys.....	43*	43*	Phila. Elec.....	15¾	15¾
Elec. Co. of A.....	11½*	11⅜*	Phila. R. T.....	19¾	19⅜
Elec. St. B'ty.....	49½	51	Phila. Trac.....	83	82
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	43⅞	44

CHICAGO.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	120	120*
Chi. Rs., Ser. 1.....	67¼*	72	Met. El. Co.....	19*	21*
Chi. Rs., Ser. 2.....	15⅞*	17⅜	Met. El., pfd.....	61*	68
Com. Edison.....	110¾	116½	Nat'l Carbon.....	127	127*
Chi. Subways.....	4⅛	5½	Nat'l Car., pfd.....	119½	119½*

BOSTON.

	Oct. 10.	Oct. 17.		Oct. 10.	Oct. 17.
Am. T. & T.....	138	139½	Mex. Tel.....	5¾*	5¾*
Cum. Tel.....	143*	143*	Mex. Tel., pfd.....	6½*	7*
Edison E., Ill.....	270	266	N. E. Tel.....	131½*	133½*
Gen. Elec.....	151	154¾	W. T. & T.....	19*	19*
Mass. E. Ry.....	19⅜*	20	W. T. & T., pfd....	90*	90*
Mass. E. Ry., pfd...	84*	84½			

*Last price quoted.
Shares sold for week Oct. 10 to Oct. 15.

Financial Notes

Edison Electric Illuminating Company of Boston.—At the annual meeting of the stockholders of the Edison Electric Illuminating Company of Boston Robert Saltonstall, who was elected in September to succeed the late George Dexter, was re-elected, as were the other retiring directors. Thomas K. Cummins was elected a member of the executive committee to succeed Mr. Dexter. The gross earnings for the year which ended June 30 were $4,709,466, an increase of about $600,000. The total net earnings were $2,602,228. After paying fixed charges, dividends and taxes, there was a surplus left of $413,548. The number of incandescent lamps connected at the close of the fiscal year (of 16-cp equivalent) was 1,432,407; the number of arc lamps, 10,919; motors, horse-power, 57,093. President Charles L. Edgar in his report said that the acquisition of the electric properties, taken over Sept. 1, 1909, had resulted in a very material increase in the earnings of the company, and that, carrying out the policy of the company to share increased earnings both with customers and stockholders, a reduction in the price of energy from 12 to 11 cents per kw-hour was made on Jan. 1, 1910, and an increase in the regular dividend from 2½ per cent to 3 per cent quarterly was made in May, 1910. The condensed balance sheet showed total assets of $28,887,130.

Chicago Consolidation Ordinance Passed.—The City Council of Chicago has passed the Consolidated Traction ordinance, clearing the way for the merging of the Consolidated Traction Company properties with that of the Chicago Railways Company. There is every reason to believe that the ordinance will be approved by the Mayor and be accepted by the Chicago Railways Company, in which case the latter company takes over the control of the Consolidated properties. The work of rebuilding the line will be started without delay. Some of the main lines may be rehabilitated this fall. The Chicago Railways Company has been making preparations to rush the work as soon as the ordinance is approved. Under the new ordinance the company must at once order 215 new cars.

Receivers for Chicago & Southern Traction Company.—Joseph E. Otis, president of the Western Trust & Savings Bank, of Chicago, and Matthew Slush have been appointed receivers of the property of the Chicago & Southern Traction Company, which operates an electric interurban railway between the southern portion of Chicago and Kankakee, Ill. The receivers were appointed on the application of the Western Trust & Savings Bank and the majority of the bondholders. The complaint filed in the Circuit Court set forth that the company had defaulted in bond interest for the last two years. The company operates 80 miles of track. Mr. Slush has been its president.

Mexican Power Plants Projected.—It is said that plans have been completed to finance in Denver $500,000 worth of securities of the Mayo River Power & Land Company, which is the beginning of a project for the construction of three large power plants on the west coast of Mexico. The company, it is said, has secured the perpetual water rights from the Mexican government on the Rio Mayo, Rio Humaya and Rio Santiago, together with 115,000 acres of agricultural, mineral and timber land. The estimated cost of the three developments is $5,682,000. Among the Denver men interested are Thomas Keely, vice-president of the First National Bank; J. B. Andrews, assistant to the president of the Denver & Rio Grande Railroad; F. F. Struby and L. T. Durbin, of the Denver Tramway Company; John T. Foster, I. B. Perkins and W. O. Temple. The combined dams and systems when completed, it is estimated, will develop 300,000 hp, and will furnish energy for railroads, factories and towns for 12,000 miles along the west coast of Mexico. It is also stated that a tentative contract has been made to furnish the Harriman lines in Mexico with energy.

Washington, D. C., Electric Lines to Merge.—It is stated that at a meeting of the stockholders of the Washington, Alexandria & Mt. Vernon; Washington, Arlington & Falls Church and Washington-Virginia Electric Railway companies last week a plan to merge the three was approved. It is understood that C. P. King, of Philadelphia, president of the first-named company, will be the head of the new corporation, and that the board of directors will include most of the members now acting in the same capacity for the various lines. The general offices of the new company will be in Washington. This consolidation is said to be the first step toward a combination with the companies in which the Goulds are interested, and which are now building electric lines between Washington and Richmond, Va. The Gould road is already in operation between Richmond and Ashland, Va.

Pacific Telephone & Telegraph Company.—While no statement has been given out of the earnings of the Pacific Telephone & Telegraph Company for the past three months, it is well known that they are showing large increases over the same period of 1909. With the increase in gross business comes the announcement that a proportionate increase is being made in the monthly allotment applied to the special maintenance reserve fund. On June 30 there was chargeable to this fund $3,406,743. This was an increase of $744,369 in the first half of the year. This reserve account is provided for from the expense account, and has been approximately $125,000 a month. It is said, however, that during the last three months the rate has been increased to $175,000 a month. It is the plan of the management of the company to increase this fund to $5,000,000.

Telephone Improvement Company.—The Telephone Improvement Company was incorporated at Albany last week, with a $3,000,000 capital, to manufacture and deal in telephone instruments, apparatus and appliances. Of this capital stock, $500,000 is to be 7 per cent cumulative first preferred, $550,000 7 per cent non-cumulative second preferred, and $1,950,000 common. This is the company formed by the consolidation of the Telechronometer Company of Rochester and the North Electric Company of Cleveland, and of which Frederick C. Stevens, formerly State Commissioner of Public Works, is the organizer and president, as detailed in our issue of Sept. 29. The principal offices will be located at Attica, N. Y., and the manufacturing plant at Rochester. The other directors associated with Mr. Stevens are: Charles H. North, James B. Hoge, of Cleveland; Merton E. Lewis and Garrison Babcock, of Rochester; Edward E. Clement, of Washington, and Alfred Stromberg, of Chicago.

Quebec Railway, Light & Power Company.—The earnings of the Quebec Railway, Light & Power Company, according to recent reports, have been substantially better during the current year than they were during 1909. The last report, showing the earnings for August, is gross $129,323, as against $115,136 the previous year. Expenses were $64,030, as against $57,659. The net earnings increased from $57,477 to $65,293. The report shows that the company is in excellent operating condition.

DIVIDENDS.

American District Telephone Company of New Jersey, quarterly, 1 per cent, payable Oct. 29.

Binghamton Light, Heat & Power Company, quarterly, preferred, 1½ per cent, common, ¾ per cent, both payable Oct. 15.

Columbus (Ohio) Railway Company, preferred, quarterly, 1¼ per cent, payable Nov. 1.

Connecticut Railway & Light Company, quarterly, both preferred and common, 1¼ per cent, payable Nov. 15.

Cuyahoga Telephone Company, preferred, quarterly, 1½ per cent, payable Oct. 31.

Edison Electric Illuminating Company of Boston, quarterly, 3 per cent, payable Nov. 1.

Electric Bond & Share Company, quarterly, preferred, 1¼ per cent, payable Nov. 1, common, 2 per cent, payable Oct. 15.

Grand Rapids Railway Company, preferred, quarterly, 1¼ per cent, payable Nov. 1.

Guanajuato Power & Electric Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent, common, 1½ per cent, both payable Nov. 12.

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Feb. 1, common, 1¾ per cent, payable Dec. 1.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable Oct. 31.

Montreal Street Railway Company, quarterly, 2½ per cent, payable Nov. 2.

Railways Company General, quarterly, 1 per cent, payable Nov. 1.

Sayre Electric Company, preferred, quarterly, 1¾ per cent, payable Oct 15.

Western Electric Company, quarterly, 2 per cent, payable Nov. 1.

REPORTS OF EARINNGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
Quarter ended Sept. 30, 1910	$8,714,616	$884,416	$7,830,199	$1,249,941	$6,580,259
Quarter ended Sept. 30, 1909	8,112,585	603,016	7,509,562	1,536,138	5,973,424
Boston Elevated Railroad Company:					
Year ended Sept. 30, 1910 (estimated)	14,178,248	8,761,868	5,416,380	4,785,792	811,920
Year ended Sept. 30, 1909	14,493,853	9,488,484	5,005,369	4,163,952	841,417
East St. Louis & Suburban Company:					
September, 1910	211,249	101,989	109,260	48,394	60,866
September, 1909	176,402	87,324	89,078	49,345	39,733
Edison Electric Illuminating Company, of Boston:					
Year ended June 30, 1910	4,709,456	2,107,228	2,602,228	.....	413,548
Year ended June 30, 1909	4,111,343	1,770,956	2,340,387	.....	411,970
Electric Light & Power Company, of Abington & Rockland:					
August, 1910	8,493	5,272	3,221	814	2,407
August, 1909	6,411	3,830	2,581	478	2,103
Houghton County (Mich.) Electric Light Company:					
August, 1910	18,261	10,721	7,540	4,553	2,987
August, 1909	18,440	10,097	8,343	4,266	4,077
Massachusetts Gas Companies:					
Year ended June 30, 1910	2,389,317	57,693	.....	300,312	2,031,312
Year ended June 30, 1909	2,102,579	55,323	.....	172,384	1,874,871
Michigan United Railways Company:					
Year ended April 30, 1910	1,233,438	684,216	549,222	360,735	203,937
Year ended April 30, 1909	1,021,128	568,157	452,971	305,891	152,747
Milford & Uxbridge Street Railway Company:					
September, 1910	23,118	16,918	6,200	2,516	3,684
September, 1909	22,199	14,037	8,162	2,839	5,323
Portland (Ore.) Railway, Light & Power Company:					
September, 1910	400,209	.....	267,627	.....	117,000
September, 1909	330,777	.....	227,340	.....	98,416
Washington, Baltimore & Annapolis Electric Railway Company:					
September, 1910	68,659	29,217	39,442	.....	.....
September, 1909	58,789	25,274	25,629	.....	.....

General News

Construction News.

BIRMINGHAM, ALA.—Plans are being prepared by the Louisville & Nashville Railroad Company for extensive improvements to its railroad shop at Boyles, which will include construction of power house, car shops, engine houses, etc., and will involve an expenditure of about $750,000.

BIRMINGHAM, ALA.—The Southern Equipment Company, 2601 Twenty-third Avenue, North, Birmingham, Ala., is reported to be in the market for an air compressor direct-connected to an alternating-current, 2-phase, 220-250-volt motor; the compressor to be capable of lifting 1,000,000 gal. of water, 80 ft., every 24 hours.

BIRMINGHAM, ALA.—The special committee appointed to make investigations as to the requirements of the municipal electric light and water works plants at North Birmingham has recommended improvements made to the systems, involving an expenditure of $38,575, of which $2,395 would be required for the electric system and include the installation of generator and switchboard, at $950; arc transformer and switchboard, at $645, and rebuilding of transmission lines, $600.

MOBILE, ALA.—The contract for installing electrical fixtures in the municipal building was awarded to the Mobile Electrical Company, of Mobile, Ala.

MOBILE, ALA.—The Mobile Light & Railway Company has awarded a contract to the Jett Brothers Contracting Company for the construction of an addition to its car barn, at Monroe Park, to cost about $11,000.

MONTEVALLO, ALA.—Plans are being considered by Dr. R. A. Berry for the installation of an electric light and power plant to provide electricity for lighting residences and power for dairy and farm machinery. The proposed plant will be located on the stream on the Berry farm.

PHŒNIX, ARIZ.—The Consolidated Telephone & Electric Company has commenced work on the erection of its long-distance telephone line from Yuma to Tucson.

PRESCOTT, ARIZ.—Preparations are being made by the Arizona Power Company for the erection of a new transmission line from Jerome to Fossil Creek, 163 miles in length. The company has secured contracts from three large irrigating companies along Verde River for energy to pump water from the river to irrigate several hundred acres of land. In the Cherry mining district several operating companies are considering the use of electricity for operating the mines. The United Verde Copper Company has recently started its 400-hp blower, utilizing electricity for operating the same. The company is also preparing to start up a 300-hp compressor, which will make a total of 2300 hp furnished by the Arizona Power Company. The cost of the transmission line is estimated at $100,000.

TUCSON, ARIZ.—Preparations are being made by the Great Western Power Company for the construction of a reservoir and power development in Sabino Canyon. The work will include the construction of a tunnel to divert the water of the canyon to permit the construction of the dam. The cost of the work is estimated at about $1,000,000. W. B. Alexander is consulting engineer.

ARKANSAS CITY, ARK.—Preparations are being made by the Southwestern Interurban Railway Company for the construction of an electric power plant in Arkansas City.

ALAMEDA, CAL.—The proposed contract between the City of Alameda and the Great Western Power Company for supplying electricity in connection with the municipal electric light plant was settled at a meeting of the City Council Oct. 4, when the Council sustained Mayor W. H. Noy's veto of the ordinance, and M. W. Simpson, city attorney, was directed to take necessary steps to have the matter submitted to the voters on referendum vote at the next city election. Opposition to an outside corporation gaining any foothold in Alameda in competition with the municipal plant was the cause of the Mayor's veto and the decision to pass the question up to the voters.

CARRVILLE, CAL.—The Trinity Gold Mining & Reduction Company is constructing a 200-ton reduction mill and electric power plant near Carrville. It is expected to have the plant in operation early in November.

INDEPENDENCE, CAL.—The Town of Independence has entered into a contract with the Board of Public Works of Los Angeles for electrical service to be furnished from the Owens River plant when completed. Under the terms of the contract the town will pay a bonus of $500, which the Board of Public Works of Los Angeles demanded toward the cost of installing the system. The cost of the lines and the transformers at Citrus Road is estimated at $1,250, and the erection of the distributing system in Independence at $500 additional. The contract is for a period of three years, under the terms of which electricity will be supplied at the following rates: Up to 8 kw, $1 per month; 8 to 50 kw, 12 cents per kw-hour; 50 to 100 kw, 11 cents; 100 to 200 kw, 10 cents; 200 to 300 kw, 9 cents; 300 to 500 kw, 8 cents, and 500 kw or more, 7 cents. The price for street lamps is fixed at $60 each per year and $10 per lamp per year for incandescent lamps of 32 cp.

LOS ANGELES, CAL.—Sealed bids will be received by the High School Board of the Los Angeles City High School District until Oct. 27 for furnishing and installing electric light fixtures in the annex to the Polytechnic High School Building.

OAKLAND, CAL.—Work has commenced on the construction of a new subsidiary power plant in the West Oakland yards of the Southern Pacific company, which will be used in connection with the project of equipping its Oakland and Alameda local lines for electrical operation. Electricity for operating the system will be transmitted from the Fruitvale power plant. The plant, complete, with equipment, will cost about $100,000.

OCEAN PARK, CAL.—The Edison Electric Company, it is reported, is constructing a new boiler house at its plant in Ocean Park.

OROVILLE, CAL.—With the settlement of the suit brought by the Great Western Power Company against the various Maack estates in this county, the power company has practically secured its rights of way for a second tower line of high-tension transmission lines from Oroville to Oakland, Cal.

PALO ALTO, CAL.—The Board of Public Works has adopted specifications for transformers for the municipal electric light plant and has authorized bids to be called for same.

PORTERVILLE, CAL.—The Porterville Interurban Electric Railroad Company is reported to have purchased a 10-acre tract in the Girder Ranch on which it proposes to erect a power plant to supply electricity to operate its proposed electric railway. The system will radiate from Porterville, extending east to the foothills apple and timber country, west to the Poplar and Woodville districts and north and east through Frazier Valley to Lindsay and Exeter, penetrating the Porterville orange districts.

RED BLUFF, CAL.—The Tehama County Telephone Company has been granted a franchise to construct a telephone system in Tehama County under the terms of which work must begin on erection of the line within sixty days. Joseph P. Tait is president of the company and H. P. Andrews is secretary.

REDWOOD CITY, CAL.—The residents of Menlo Park and Fairs Oaks, near Redwood City, have organized a lighting district and will establish an electric lighting system.

SACRAMENTO, CAL.—Notice of appropriation of 10,000 in. of water in Mill Creek, to be used for power purposes, has been filed by T. H. Ramsey.

SANTA BARBARA, CAL.—Preparations are being made by the Santa Barbara Gas & Electric Company for the construction of a transmission line, carrying 10,000 volts, from its power station on Castillo Street to the substation in Montecito, at an approximate cost of $10,000. Work will commence on construction of the substation as soon as the site is selected.

SANTA CRUZ, CAL.—The City Council has accepted the proposition of the Coast Counties Light & Power Company to supply power for sewage pumping system at $150 per month, and to install a new street lighting system throughout the city, consisting of 100 arc lamps, and to furnish electricity for same at $4.50 each per month. The municipal electric plant is worn out and would have to be practically rebuilt to meet the demands made upon it. The Council decided that the prices offered by the Coast Counties Power Company for the service were cheaper than the municipal plant could furnish it. S. Waldo Coleman is manager of the Coast Counties Light & Power Company.

PALISADE, COL.—Application has been made to the City Council by the Mutual Light, Power & Telephone Company for a twenty-year franchise to furnish electricity for lamps and motors in Palisade. The company proposes to erect a plant at the Farmer's Mine, east of the town, where cheap fuel can be obtained. It also proposes to supply electricity in Palisade and Clifton and also to the farms and orchards between the two places. The company agrees to turn the plant over to the city at any time after an appraisement has been made and also that the maximum charge for energy for lamps shall not exceed 10 cents per kw-hour. The capital stock of the company is placed at $50,000. The incorporators are: H. H. Younger, H. R. Hough, C. Crew, H. L. Davis and others, all of Palisade.

PUEBLO, COL.—The Pueblo & Suburban Traction & Lighting Company is contemplating the construction of an interurban electric railway from Pueblo to La Junta, for which surveys are being made. John F. Vail is general manager.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Oct. 26 for furnishing 500 miles of 11-strand field wire and three miles twin-conductor field wire. Captain A. S. Cowan is chief signal officer.

WASHINGTON, D. C.—The Commissioners of the District of Columbia are considering the question of restoring the lamps on the suburban

roads. Recently 347 lamps were discontinued on the ground that the cost of maintenance could be better applied to the illumination of other sections of the districts.

WEST PALM BEACH, FLA.—The plant and holdings of the West Palm Beach Telephone Company have been purchased by M. E. Gruber and others, of West Palm Beach. The new owners will make improvements and extensions to the system, work on which will begin at once.

ATLANTA, GA.—The Georgia Power Company, successor to the North Georgia Electric Company, has filed with the city clerk its acceptance of the terms of the franchise offered by the Atlanta City Council, and a bond of $25,000 has been deposited by the power company with the city. The company has been granted a fifty-year franchise, under the terms of which the company is given the right to sell electricity for lamps, heat and motors, paying the city to begin with one per cent of its gross income, to be increased eventually to 3 per cent. The company will furnish the service from its large hydroelectric power plant, located near Gainesville, Ga.

BRUNSWICK, GA.—The City & Suburban Railway Company has applied to the State Railroad Commission for permission to issue $100,000 in capital stock and $200,000 in first mortgage bonds.

DALTON, GA.—The Oconee Power Company, of Cleveland, Tenn., has applied to the City Council for a franchise to furnish electricity in Dalton, Ga.

DALTON, GA.—Bonds to the amount of $125,000 have been sold by the City of Dalton, the proceeds to be used for improvements to the municipal electric light plant and other purposes. H. S. Jaudon, of Savannah, Ga., is consulting engineer.

DUBLIN, GA.—At an election to be held in December the proposition to issue $25,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant and water works system, will be submitted to a vote.

FAIRBURN, GA.—The State Railroad Commission has granted the Fairburn & Atlanta Railway & Electric Company permission to issue $75,000 in capital stock and $50,000 in first mortgage bonds. The company is building an electric railway from Fairburn to College Park.

GRIFFIN, GA.—The Spalding Cotton Mills Company has awarded the Central Georgia Power Company, of Macon, Ga., a contract to supply electricity to operate its mills, consisting of 12,000 spindles and a large number of looms. The power company has nearly completed its distributing station at Griffin, Ga.

MACON, GA.—It is reported that the Massaa & Felton Lumber Company will equip its plant for electrical operation. The company, it is stated, has contracted for electricity.

MILLEDGEVILLE, GA.—Improvements are being made to the local street lighting system, including the installation of many new arc lamps and rearrangement of old lamps. An all-night service has recently been established. The electrical service is supplied by the electrical department of the Oconee River Mills.

NICHOLLS, GA.—The Nicholls Telephone Company has awarded the contract for the installation of an exchange in Nicholls to D. H. Peterson, of Peterson & Hughes, of Douglas, Ga.

THOMASVILLE, GA.—A new engine is being installed in the municipal electric light station. This will double the output of the plant.

HONOLULU, HAWAII.—The local telephone company at Hilo is contemplating the construction of a new telephone exchange, to cost not less than $25,000.

BURKE, IDAHO.—The Marsh Mining Company is building a machine shop on its property in Burke, which, it is said, will be equipped for electric motor drive.

LEWISTON, IDAHO.—It is reported that the Independent Telephone Company is planning to extend its toll lines from Spokane to Lewiston, connecting here with the Nez Perce co-operative system.

LEWISTON, IDAHO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 22, for construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States post office building at Lewiston, Idaho, in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Lewiston, Idaho, or at the above office. James Knox Taylor is supervising architect.

LUCILE, IDAHO.—Plans are being considered by the United Placer Mines Company for the installation of a 5000-hp hydroelectric plant in Lucile. Walter Hovey is consulting engineer.

SANDPOINT, IDAHO.—It is reported that the Idaho Power & Concentrating Company will soon award a contract for the construction of a flume 7150 ft. in length, and other improvements to its plant at Trestle Creek, which will involve an expenditure of from $30,000 to $40,000.

BELVIDERE, ILL.—The City Council is considering the question of establishing a municipal electric plant in Belvidere.

CHICAGO, ILL.—Preparations are being made by the Chicago City Railway Company to extend its railway from the Sixty-third Street line through the Stickney tract, to connect with the Chicago & Joliet Electric Railway, near the Corn Products plant.

JOLIET, ILL.—Work has commenced on the construction of the new power plant of the Illinois Steel Company in Joliet. The plans call for the erection of a new power house, the equipment to include three 3000-kw gas generating units. The new plant will replace the present steam engines and steam-driven pumps, and the entire works will be equipped for electrical operation. Waste gas from coke ovens will be utilized for fuel. The cost of the plant complete is estimated at about $1,000,000.

STREATOR, ILL.—The plant and holdings of the D. Heenan Lighting Company are reported to have been purchased by the W. H. Schott Company, of Chicago, Ill. It is understood that the new owners will extend the heat and lighting systems throughout the city.

INDIANAPOLIS, IND.—The Washington Hydraulic Company, recently incorporated with a capital stock of $25,000, is planning several power developments along the Tippecanoe River. The company proposes to construct a series of dams across the Tippecanoe River to create backwater at points from the mouth of the river north to Jefferson Township and Carroll Township, a distance of 16 miles. The power will be utilized to generate electricity. The directors are Harry Wade, A. J. Hammond, Daniel E. Storms, A. E. Wade and James E. Watson. The headquarters of the company are located at 308 K. of P. Building, Indianapolis, Ind.

PORTLAND, IND.—The Jay County Commissioners have granted a franchise to S. B. Smith, representing a syndicate formed to supply electricity for lamps and motors in several towns and cities in eastern Indiana.

PRINCETON, IND.—The machine shop and power plant of the Southern Railway Company, at Princeton, Ind., was damaged by fire on Oct. 8, causing a loss of $200,000. The other departments were badly crippled owing to the destruction of the electric generators and air compressors. The plant will be rebuilt at once.

ALBIA, IA.—The Oskaloosa Home Telephone Company has purchased the controlling interest in the Albia Telephone Company, which operates an exchange of about 1000 connections. It is understood that plans are being considered for rebuilding the exchange and installing the central battery system. J. S. Moon will be retained as president and John Renz as manager of the company.

HOSPERS, IA.—William Stovers has submitted a proposition to the Commercial Club offering to install an electric light plant in Hospers provided that sufficient number of residents subscribe for electrical service.

MAGNOLIA, IA.—At an election held Oct. 11 the citizens voted in favor of the proposition to grant the Bullock Public Service Company, of Omaha, a franchise to construct and operate an electric light plant in Magnolia. E. A. Bullock, of Omaha, Neb., is president of the company.

OTTUMWA, IA.—The Ottumwa Railway & Light Company is erecting a new power plant on South Jefferson Street in Ottumwa. The power house will be 112 ft. x 34 ft. of brick and concrete construction.

ATCHISON, KAN.—The stockholders of the Atchison Railway, Light & Power Company have authorized an increase in capital stock of the company from $900,000 to $1,500,000, the proceeds to be used for improvements and extensions to its system. The property of the Atchison company was recently purchased by the McKinley syndicate. Announcement has been made that the McKinley syndicate will extend the railway to St. Joseph, Topeka and Kansas City.

CANTON, KAN.—The Motor Grand Traction Company, which was formed about a year ago, has been reorganized with the following officers: M. M. Bremen, of Roxbury, president; S. M. Law, of Canton, vice-president; S. A. Blue, of Canton, secretary; C. M. Gray, of Canton, treasurer, and B. F. Dole, of Doles Park, general manager. The company proposes to construct and operate an electric railway from Canton to Roxbury.

COUNCIL GROVE, KAN.—The local electric light plant is reported to have been purchased by the R. J. Rhodes Lumber Company at a receiver's sale. The new owners, it is said, will continue to operate the plant and propose to reconstruct the plant and install new machinery as soon as possible. J. J. Rhodes is manager of the lumber company.

HOPE, KAN.—Contracts have been awarded for material and equipment for the municipal electric plant as follows: For switchboard, instruments, regulators, transformers, etc., to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $1,424, and for material for pole line, etc., to the Western Electric Company, of New York, N. Y., at $6,399. D. L. Stromquist, superintendent of the Herrington Water and Light Department, has charge of the work.

MANHATTAN, KAN.—The Rocky Ford Milling & Power Company, which operates a power plant on the Blue River, four miles north of Manhattan, has been reorganized under the name of the Blue River Power Company. Plans are being made to increase the output of the power house to 1000 hp, machinery for which has already been purchased. The plant furnishes electricity for operating the Rocky Ford mill and also to the City of Manhattan. The company will supply energy to operate the pumping station in Manhattan.

NATIONAL MILITARY HOME, KAN.—Sealed bids will be received at the office of the treasurer of the Western Branch, National Home Disabled Volunteer Soldiers, National Military Home, Kan., until Oct. 22 for furnishing and installing an electric elevator in the general mess hall building. Plans may be seen at the office of the quartermaster and specifications and blank proposals and other information may be obtained upon application to Major W. W. Martin, treasurer.

PRETTY PRAIRIE, KAN.—The Town Board has granted a franchise

to J. J. Siebert to establish an electric light plant in Pretty Prairie. The franchise provides for a maximum charge of 17½ cents per kw-hour.

COVINGTON, KY.—The Covington, Big Bone & Carrollton Railroad Company has applied to the City Council for a franchise to extend its railway in the lower section of Covington. The company is planning to construct a railway to connect Covington and Big Bone, 22 miles in length. M. J. Crouch is interested in the company.

NEWPORT, KY.—It is reported that the Newport Rolling Mill Company is in the market for an electric generating unit, including a 300-kw, 200-volt, direct-current generator, direct connected to an automatic non-condensing engine, complete, with switchboard and instruments.

PAINTSVILLE, KY.—Plans are being prepared for the construction of an electric light plant and water-works system in Paintsville, Ky. Stuart H. Bowman and H. H. Hughes, of Huntington, W. Va., are reported to be interested in the project.

LEWISTON, MAINE.—Preliminary plans are being made by the Union Electric Company, of Lewiston, Maine, for the construction of a hydroelectric development at Clarks Rips, Lewiston. The proposed plant will develop about 20,000 hp, which will be transmitted to Lewiston and Auburn, a distance of about ten miles, to be utilized for industrial purposes. The old Googin dam, located about a mile below the site of the proposed dam, is to be repaired and used to generate power to operate the machinery during the process of construction.

ANNAPOLIS, MD.—All proposals received Oct. 1 for power plant equipment to be delivered at the Naval Academy, Annapolis, Md., have been rejected and the work will be readvertised at an early date on amended specifications.

ANNAPOLIS, MD.—The contract for addition to the power plant and distributing system at the Naval Hospital, bids for which were opened Sept. 10, has been awarded to the Noel Construction Company, of Baltimore, Md., at $19,200.

ANNAPOLIS, MD.—Bids will be received at the Navy Department, Washington, D. C., until Nov. 12 for completing power plant at the United States Naval Academy, Annapolis, Md. Plans and specifications can be obtained on application to the superintendent of the Naval Academy, Annapolis, Md., for which a deposit of $10 will be required to insure return of same. Beekman Winthrop is acting secretary.

HAGERSTOWN, MD.—It is reported that negotiations are under way with the Hagerstown Street Railway Company to extend its railway from Williamsport across the Potomac River into Berkeley County to North Mountain, Tomahawk, Glengary and other points.

BOSTON, MASS.—Preparations are being made by the Boston & Maine Railroad Company for the construction of locomotive and repair shops, which will involve an expenditure of about $2,500,000, work on which will commence immediately. It is understood that the shops will be located in the vicinity of Boston.

BOSTON, MASS.—Sealed proposals will be received at the office of Fred H. Seavey, county sheriff, until Oct. 31, for installation of electric wires, fixtures and appurtenances for the male portion of the Suffolk County jail and the residence of the sheriff of Suffolk County, adjacent to the jail, in accordance with plans and specifications, which may be secured at the above office.

CLINTON, MASS.—It is reported that a deal has been closed between the Connecticut River Power Company and the Metropolitan Water Board whereby the Connecticut company will purchase all the energy generated at the Wachusett Reservoir dam, at Clinton, Mass. The additional power will be used in connection with its system, which supplies electricity to Worcester and Fitchburg, Mass., and other cities and towns. An appropriation of $125,000 has been made by the State of Massachusetts for establishing a power station at the dam to develop from 2500 hp to 3000 hp. The reservoir supplies water to the City of Boston and surrounding cities and towns. The contract is for a period of five years.

FITCHBURG, MASS.—The Boston & Maine Railroad Company is reported to be contemplating equipping its repair shops in East Fitchburg for electric-motor drive, electricity for which will be purchased from a local company.

FITCHBURG, MASS.—The New York, New Haven & Hartford Railroad Company has awarded the contract for equipping the Hoosac tunnel for electrical operation to the Westinghouse Electric & Manufacturing Company. The contract includes complete equipment of the tunnel and erection of power plant capable of generating sufficient power to handle all trains at that point. The cost of the work is estimated at about $1,000,000, work on which will begin at once. The tunnel is nearly 5 miles in length.

HOLYOKE, MASS.—The Board of Public Works is contemplating the installation of tungsten lamps for street lighting. It is expected that tungsten lamps will be placed on many of the streets, eventually replacing the arc lamps now in use.

MARION, MASS.—The Marion Gas & Electric Company is contemplating extending its system to Bourne. The company now supplies electrical service as far as Onset.

BAY CITY, MICH.—The State Railroad Commission has granted the Bay City Power Company permission to issue bonds to the amount of $500,000, the proceeds to be used for extensions to its system, including the purchase of additional machinery.

DETROIT, MICH.—The Edwin Armstrong Company, of Detroit, Mich., is reported to be securing estimates for power plant equipment for its new tannery.

DETROIT, MICH.—Edmunds & Jones, 404 Moffat Building, Detroit, Mich., it is reported, are having plans prepared for an addition to their automobile factory, 67 ft. x 200 ft., three stories high, also a power plant.

GRAND RAPIDS, MICH.—Contingent upon the reorganization of the Grand Rapids-Muskegon Power Company, which will probably be effected within ninety days, extensive improvements are contemplated. Plans are being prepared for extension of transmission lines to North Park, Mill Creek, Spring Lake, and from the Kent City substation to Casnovia, Sparta and along the lake front at Muskegon. The cost of the work is estimated at $200,000.

HILLMAN, MICH.—It is reported that interests connected with the Hillman Electric Light & Water Company are contemplating the installation of another hydroelectric power plant in this vicinity.

INTERLOCHEN, MICH.—Plans are being prepared by Harlin Brown for the construction of a hydroelectric power plant in Interlochen for the purpose of supplying electricity for lamps and motors in the towns of Mesick, Buckley, Wexford, Glengarry, Harrietta, Interlochen and Traverse City and surrounding districts.

SIDNAW, MICH.—A company, composed of local business men, is reported to have purchased the electric light plant which was damaged by fire some time ago.

AUSTIN, MINN.—The Electric Light and Water Board has awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for a 750-kw generator, for $17,600.

COLERAINE, MINN.—The Oliver Iron Mining Company is planning to supply electricity for industrial purposes in Coleraine and to surrounding towns.

HIBBING, MINN.—Preparations are being made for the installation of a new street lighting system. Fifty-six magnetite arc lamps and constant-current transformer will be installed, contract for which has already been placed.

LAKEFIELD, MINN.—Plans are being considered by the Village of Lakefield to enlarge the municipal electric light plant. The installation of a new generator is under consideration.

ST. PAUL, MINN.—The St. Paul Promotion Company, recently incorporated, is planning to begin work on the construction of its proposed system of interurban railways, radiating from St. Paul to Farmington, Northfield, Faribault, Mankato and other southern Minnesota cities. Philip W. Herzog is president of the company.

BAY ST. LOUIS, MISS.—The question of calling an election to vote on the proposition to issue $75,000 in bonds, the proceeds to be used for the construction of an electric light plant, street work, etc., is under consideration by the City Council.

ROLLA, MO.—It is reported that the City Council is contemplating extending the municipal electric lighting system into the territory recently taken over by the city.

ST. LOUIS, MO.—The West End Light & Power Company is reported to be making preparations for the construction of its proposed electric plant.

AVON, MONT.—The Avon Local Home Telephone Company, recently organized with a capital stock of $10,000, is planning to install a telephone system in Avon, work on which will begin at once.

CLINTON, MONT.—Arrangements are being made by the Triangle Mining & Development Company, of Missoula, Mont., for the installation of machinery for a 100-ton concentrating plant on its property in Clinton in the near future. All the machinery will be equipped for electric motor drive. Electricity for operating the plant will be secured from the Bonner plant of the Missoula Light & Water Company.

HELENA, MONT.—It is reported that the City Council is contemplating replacing the present arc-lamp system with tungsten lamps.

LIBBY, MONT.—Plans are being considered for the installation of an electric light plant, water works and telephone systems in Libby, at a cost of about $100,000.

SACO, MONT.—Plans are being prepared by the Moore Telephone Company for the erection of a new exchange. A new switchboard will be installed.

OMAHA, NEB.—All proposals for installing electric wires and conduits for power and light wires and also for telephone conduits for the Douglas County court house, bids for which were opened Oct. 10, were rejected. J. W. Bedford is county commissioner.

SILVER CREEK, NEB.—The Village Board is reported to have granted a franchise to Messrs. Ives and Brown Brothers to install and operate an electric light plant.

BERNARDSVILLE, N. J.—The Bernardsville Water Company has submitted a proposition to the commissioners offering to furnish electric incandescent lamps of 30 cp instead of 25-cp lamps at the rate of $15 each per year, instead of $12 per lamp as under the present contract. The company also agrees to keep fixtures and lines in repair and to renew lamps without charge.

NEWARK, N. J.—The Common Council has adopted a resolution calling for the extension of the City Hall lighting plant. It is proposed to use the excess power to light the Center Market and such fire houses and other public buildings as can be supplied by the city plant.

NEWARK, N. J.—The Public Service Railway Company has awarded a contract to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for two 5000-kva, 13,200-volt, three-phase, 60-cycle, 1800 r.p.m. turbo-generators, to be installed in the new power house at Perth Amboy, N. J.

ALBIA, N. Y.—Preparations are being made by William C. Geer for the construction of a hydroelectric power plant. The plant will be located on the Burden Pond and will develop about 300 hp. A company has been organized under the name of the Geer Hydro-Electric Power Company to operate the plant and will supply electricity to operate the mills of the Troy Knitting Company and the Albia Box & Paper Company, of Albia. Surveys are now being made and it is expected to have the plant completed by spring.

BOLTON LANDING, N. Y.—It is reported that the taxpayers of Bolton Landing have signed a petition asking the Town Board to enter into a contract with the Bolton Light & Power Company to supply electricity for lighting the streets and municipal buildings for a term of ten years.

NEW YORK, N. Y.—Notice has been given by the supervising architect, Treasury Department, Washington, D. C., that the date for receiving bids for electric elevator equipment, pneumatic door operating system and construction of the new post office building at New York, N. Y., has been extended from Nov. 3 to Dec. 1, 1910. James Knox Taylor is supervising architect.

OSSINING, N. Y.—The Hudson River & Eastern Traction Company has applied to the Public Service Commission for authority to issue $50,000 additional capital stock and $850,000 in bonds. The company operates an electric railway in Ossining and is contemplating extending its railway from the present terminus in Ossining to White Plains, a distance of about 14 miles, at a cost of about $621,000.

UTICA, N. Y.—The Utica Gas & Electric Company has placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for two 1000-kva, self-cooled, new tubular type transformers.

WILLIAMSTON, N. C.—The contract for lighting the town by electricity has been awarded to the Virginia-Carolina Peanut Company, of Williamston.

ADDYSTON, OHIO.—Bids will be received until Oct. 25 by Benjamin Fangman, village clerk, for lighting the streets, alleys and public places in the village, the bidders to state the cost per lamp.

ASHTABULA, OHIO.—The American Fork & Hoe Company is reported to be preparing plans to double the output of its power plant.

CINCINNATI, OHIO.—The Board of Hospital Commissioners will receive bids until Oct. 25 for light figures for the contagious hospital group. Samuel Hannaford & Sons, Sixth Avenue & Vine Streets, Cincinnati, Ohio, are architects.

CLEVELAND, OHIO.—The Cleveland, Barberton, Coshocton & Zanesville Railway Company is reported to have awarded the contract for the construction of its proposed railway to connect Cleveland and Zanesville to the Canadian Construction Company, of Quebec, Que., Can. J. J. Breittinger is president of the railway company.

COLUMBUS, OHIO.—It is reported that plans are being prepared for the construction of a new factory for the Felber Biscuit Company, of Columbus, Ohio. The building will be equipped for electrical operation, sprinkler system, etc.

COLUMBUS, OHIO.—It is reported that the Public Securities Company, recently incorporated with a capital stock of $160,000, will take over the gas and electric plants in Hyomea, Spencer and Coal Mont, Ind., and reorganize the properties. Carl J. Kiefer, G. B. Gilbert, Jackson Keifer, E. M. Gilligan and Henry Kiefer are interested in the company.

DAYTON, OHIO.—The Dayton Motor Car Company is reported to be erecting an addition, 46 ft. x 56 ft., to the power house of plant No. 3.

DAYTON, OHIO.—The C. W. Raymond Company, manufacturer of clay-working machinery, is constructing a large plant at Bolander Street and Broadway, in this city. Several of the buildings have been erected and machinery installed. The plant will be equipped for electric motor drive throughout. Apparatus yet to be provided includes equipment for power plant and some special machinery for the main shop.

LEBANON, OHIO.—Preparations are being made by the Valley Telephone Company for extensive improvements to its local system, including the erection of a new exchange building and the placing of its wires in underground conduits.

FAIRVIEW, OKLA.—The City Council, it is reported, is contemplating making extensions to the municipal electric light system.

TULSA, OKLA.—The capital stock of the Oklahoma Union Traction Company has been increased from $100,000 to $400,000. The company is planning to construct a bridge across the Arkansas River and extend its railway to West Tulsa in the near future. L. Cox is superintendent.

FOREST GROVE, ORE.—Improvements and extensions have been made to the municipal electric light plant, including the installation of a new boiler and engine, at a cost of about $8,000. A day service will be established to furnish electricity for small motors.

LAKEVIEW, ORE.—The Lakeview-New Pine Creek Electric Company is reported to be contemplating the erection of a telephone line from Adel to Bidwell, 32 miles in length.

UNION, ORE.—At an election held recently the proposition to issue bonds for the installation of an electric light plant and for repairs to water works system was carried.

BERLIN, PA.—It is reported that H. G. Kaylor and associates are contemplating the construction of an electric railway to connect Berlin, Somerset and Garrett, for which surveys are being made.

CLARION, PA.—Preparations are being made by the Clarion & East Brady Electric Railway Company for the construction of the first section of its proposed electric railway to Reidsburg, a distance of six miles. The proposed railway will be thirty miles in length and will connect Clarion, Reidsburg, Sligo, Rimersburg and East Brady. The power house will be located in Clarion. It is understood that the company also proposes to furnish electricity for lighting. G. E. Arnold is president.

IRWIN, PA.—Preparations are being made by the Pittsburg, McKeesport & Westmoreland Railway Company for the construction of an electric power plant adjoining its car barn on the Westmoreland line. The proposed plant will furnish electricity for operating its cars and also for lamps and motors to the towns along the State Road, including Circleville, Jacktown, Hahntown, Rillton, Herminie, Irwin and other towns. Contracts for the construction of the buildings and generating machinery have been placed. The equipment will include one 200-hp Buckeye engine, two Babcock & Wilcox boilers, with a rating of 150 hp each, one 150-kw Westinghouse generator with separators, feed water pumps, tanks, etc.; also one 100-hp Buckeye engine and one 75-kw alternating-current generator for lighting service. The cost of the plant is estimated at $30,000. The company now purchases power for operating its system from the West Penn Electric Company. Manning Stires, of McKeesport, Pa., is general superintendent.

McCALL FERRY, PA.—The power plant of the Pennylvania Water & Power Company was placed in operation Oct. 14. Electricity generated at the plant is now being supplied to the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md. The power company is now negotiating with the United Railways & Electric Company in regard to furnishing the latter with power.

PITTSBURGH, PA.—The West Penn Railways Company is reported to be contemplating extending its railway from Fayette City to Donora.

PITTSBURGH, PA.—The American Locomotive Works is reported to be preparing plans for the construction of a new power plant and special equipment for its works on the lower North Side. It is proposed to equip the plant as far as possible for electric motor drive. The plans contemplated will involve an expenditure of about $500,000.

PITTSBURGH, PA.—The Common Council has approved the ordinance authorizing contracts for electric arc lamps for street lighting for a term of two years at a cost not to exceed $335,000 a year, and for incandescent mantle lamps, the cost not to exceed $105,000. It also has authorized a contract for the construction of a pumping station on the South Side at a cost of $100,000.

WILKES-BARRE, PA.—The Wilkes-Barre Railway Company is reported to be contemplating extensive improvements to its system, including the construction of a new power house and extension of its high-tension wires out of the city.

MOBRIDGE, S. D.—W. W. Seymour, of Philadelphia, Pa., is reported to be contemplating the installation of an electric light plant in Mobridge.

NASHVILLE, TENN.—The Great Falls Power Company, recently organized, proposes to construct a large hydroelectric power plant on the Caney Fork River. Electricity generated at the plant will be transmitted to Nashville to be utilized for industrial purposes. It is expected that work on development of the plant will begin this winter. Fielding H. Yost, Daniel E. McGugin and others are interested in the project.

SHELBYVILLE, TENN.—Preparations are being made for extensive improvements to the local electric light plant, owned by J. F. Boyd, which will include the installation of four new water wheels, a 400-kw generator and construction of new concrete penstock and power house. The cost of the work is estimated at from $20,000 to $30,000. Soloman-Norcross Company, of Atlanta, Ga., has charge of the engineering work.

EL PASO, TEX.—The El Paso Electric Railway Company is reported to be considering the question of extending its railway to Ysleta, a distance of 10 miles.

GREENVILLE, TEX.—The City of Greenville, it is reported, has purchased the electric plant owned by H. T. Weathers, of Greenville, for a consideration of $4,000. It is understood that the city will take over the plant Dec. 1 and operate it in connection with the municipal plant. Some changes will be required, as the city plant generates alternating current and the Weathers plant is equipped with direct-current machinery.

GREENVILLE, TEX.—It is reported that the Greenville Railway & Light Company will install machinery in the municipal electric light plant, at a cost of from $8,000 to $10,000, to convert the alternating current generated at the plant into direct current, to be utilized to operate the street railway system, in accordance with an agreement between the company and the City Council, under which the city is to furnish electricity for the street railway and the company to supply and install the equipment.

HEMPSTEAD, TEX.—Work is being pushed rapidly on the new electric light plant in Hempstead. It is expected to have the plant ready for operation by Dec. 1.

KIRBYVILLE, TEX.—The installation of an electric light plant in

Kirbyville is under consideration. W. R. Hancock is interested in the enterprise.

NEW BRAUNFELS, TEX.—The City Council has voted to construct a dam across the Guadalupe River. The proposed dam will furnish about 400 hp, the larger part of which will be utilized by the city. An election will be called to vote on the proposition to issue $75,000 in bonds to build the dam.

PECOS, TEX.—The Pecos Light & Ice Company is reported to be contemplating enlarging its plant.

TEXARKANA, TEX.—The Texarkana Gas & Electric Company is contemplating several extensions to its street car system to the suburban districts.

ROXBURY, UTAH.—The Commercial Club of Roxbury has endorsed a proposition to construct an electric interurban railway from Roxbury to St. Anthony.

HARRISONBURG, VA.—The Town Council has decided to adopt the meter system for furnishing electricity for lamps and will discard the present flat-rate system.

HIGHLAND PARK (P. O. RICHMOND), VA.—The Virginia Railway & Power Company has been granted a franchise by the Town Council to construct and operate an electric light system in Highland Park.

WYTHEVILLE, VA.—It is reported that preparations are being made by the Stone Electric Light & Power Company for improvements to its electric plant. It is understood that a steam plant will be installed at the Wytheville Manufacturing Company's plant in addition to the hydroelectric plant.

ELMA, WASH.—The Chehalis Fir Door Company is reported to be contemplating the erection of a large woodworking plant this fall, which will be equipped for electrical operation.

LOON LAKE, WASH.—The Blue Grouse Tungsten Company, it is said, will require machinery for ore concentration and other purposes in the near future.

MONTESANO, WASH.—Sealed bids will be received by Fred Rosmond, county auditor, until Nov. 7 for furnishing and installing electric fixtures and incandescent lamps in the new court house in Montesano, Wash., in accordance with plans and specifications on file at the office of the county auditor, Montesano, or at the office of Watson Vernon, architect, 447 Finch Building, Aberdeen, Wash.

SEATTLE, WASH.—The Seattle-Tacoma Short Line Company is reported to have awarded a contract for clearing the right of way for its proposed electric railway between Youngstown and Buren Lake. It is expected to have the railway in operation in two years. The engineering offices of the company are located in Seattle. J. B. Murphy is president of the company.

SEATTLE, WASH.—Plans are being considered by the City of Seattle to construct an auxiliary power plant next year, to be located on the shore of Lake Union. Power for operating the plant will be supplied from the Volunteer Park reservoir. The proposed new plant will generate 2000 hp at a small expense, as the waste water from the reservoir will be utilized to operate the plant. From Volunteer Park to the shore of Lake Union there is a drop of 400 ft. A reservoir of about 200,000 cu. ft. capacity will be built. The University of Washington has been asked to join with the city in building the auxiliary plant.

SPOKANE, WASH.—Negotiations are reported to be under way between real estate dealers and the Spokane Traction Company with a view of having the company extend its Corbin Park line northwest and beyond the city limits about two miles. The cost of the work is estimated at about $28,500.

WHITE SALMON, WASH.—The Swan-Hamann Company, which has recently installed an electric generating unit to supply electricity for lighting its plant, it is understood, will later extend the system and equip its mill for electric motor drive.

BETHANY, W. VA.—Extensive improvements are contemplated at the Bethany College, including the erection of a new dormitory, installation of an electric power and heating plants. The electric plant will supply electricity for lighting the Town of Bethany as well as the college.

MORGANTOWN, W. VA.—Surveys are being made by the South Morgantown Traction Company for the proposed extension of its railway to the old Fairmount Fair grounds, a distance of 12 miles. Dudley D. Britt, of Clarksburg, W. Va., is chief engineer.

PARKERSBURG, W. VA.—It is reported that the Parkersburg Electric Light Company is making arrangements to install additional machinery in its power plant, contracts for which have already been awarded. It is proposed to increase the output by 2000 kw. C. H. Shattuck is president of the company.

SWITCHBACK, W. VA.—The Pocahontas Consolidated Company has awarded the contract for the construction of its proposed power house, to cost about $50,000.

BENTON, WIS.—The Minnie Mining Company is reported to be installing a large gasoline engine to operate the hoist and pumps at its mines. The other machinery will be equipped for electric-motor drive, for which electricity will be supplied by the Interstate Power Company, of Galena, Ill.

CASSVILLE, WIS.—It is reported that contracts have been awarded by the Adams Patent Wheel Company, of Cassville, Wis., for the construction of a new manufacturing plant and power house.

MILWAUKEE, WIS.—The Vilter Manufacturing Company, of Milwaukee, Wis., manufacturer of Corliss engines, ice-making and refrigerating machinery, is making improvements and extensions to its machine shops, including the installation of electrical operating machinery.

NEW HOLSTEIN, WIS.—At an election held recently the proposition to establish a municipal electric light and power plant was defeated. It is understood that the question will be submitted to the voters again.

NEW RICHMOND, WIS.—The New Richmond Roller Mills Company has recently completed the installation of a steam-driven electric power plant, to be used as an auxiliary to its twin water power plants at Huntington, located on the Apple River, five miles from New Richmond. The equipment includes an 800-hp steam turbine and a 525-kw generator. The installation of the steam plant was necessary owing to the low water in the Apple River.

PRAIRIE DU SAC, WIS.—Preparations are reported to be under way by the Wisconsin Power Company for the construction of a large hydroelectric power plant at Prairie du Sac, Wis., on the Wisconsin River. Magnus Swenson, of Madison, Wis., is president of the company.

WEST ALLIS, WIS.—It is reported that bids are being received by Vaughn & Meyer, Majestic Building, Milwaukee, Wis., for motors and other electrical equipment, exclusive of generating units, for the new plant of the Kempsmith Manufacturing Company, at West Allis, Wis. It is understood that the generating machinery has already been purchased.

CALGARY, ALTA., CAN.—Sealed bids will be received by the Commissioners of the City of Calgary until Nov. 12 for furnishing the City of Calgary material and equipment, including rails, cars, overhead material, etc., for extensions to the municipal street railway system. Plans and specifications may be obtained on application to the commissioners. W. D. Spence is city clerk.

ST. BONIFACE, MAN., CAN.—The citizens of St. Boniface are considering the question of asking the provincial government to supply electricity in this territory on a similar plan to that under the control of the Hydroelectric Power Commission in Ontario.

GALT, ONT., CAN.—The Town of Galt is offering debentures to the amount of $66,000, the proceeds to be used for the installation of a municipal plant and distributing system for electricity to be supplied by the Hydroelectric Power Commission in Galt.

LONDON, ONT., CAN.—The London & Northwestern Railway Company has been granted a charter to construct an electric interurban railway between London and Sarnia, 114 miles in length. It is reported that arrangements have been completed and work will begin on construction of the road in the near future. The company is capitalized at $500,000. Daniel A. Stewart is interested in the company.

RENFREW, ONT., CAN.—Debentures to the amount of $117,000 are being offered by the Town of Renfrew, the proceeds to be used for the construction of a municipal plant and distributing system for electricity in connection with the Hydroelectric Power Commission project.

TORONTO, ONT., CAN.—The injunction obtained by the Toronto Electric Company against the City of Toronto, restraining it from erecting poles and wires in the streets of Toronto, has been dismissed, and the city will proceed with the erection of its transmission lines.

MAISONNEUVE, QUE., CAN.—The City Council has awarded the contract for street lighting to the Dominion Light, Heat & Power Company for a period of ten years, under the terms of which the company is to supply arc lamps of 2000 cp at the rate of $80 each per year. The city now pays the Royal Electric Company $115 per lamp per year for 1200-cp lamps. Under the new contract the city will save $35 per year per lamp.

MONTREAL, QUE., CAN.—Preparations are being made by the Shawinigan Water & Power Company for increasing the output of its power plant on the St. Maurice River at Shawinigan Falls. The proposed work will include cutting out a section of the side of the intake canal 1000 ft. long and erecting a concrete and steel bulkhead at an angle of 60 degrees to the present bulkhead. From this extension five steel penstocks, each having a capacity of 15,000 hp, will be carried to the power house to be erected on the lower level, on which there will be a head of 150 ft. The power house equipment will include five units, consisting of turbine water wheels direct-connected to electric generators.

SHERBROOKE, QUE., CAN.—Plans are being prepared by Messrs. Ross and Holgate, of Montreal, Que., Can., for the construction of a new power house on the Magog River. The proposed plant will develop about 3000 hp.

PRINCE ALBERT, SASK., CAN.—The City Council has engaged Charles Mitchell, of Toronto, Ont., Can., electrical engineer, to prepare plans and specifications for the development of water power at Lacelle Falls for the municipality. It is proposed to develop about 10,000 hp, at a cost of about $100,000, beginning with an initial installation of 3000 hp next May.

YORKTON, SASK., CAN.—Contracts have been granted for apparatus for the municipal electric light plant as follows: For meters to the Canadian Westinghouse Company, Ltd., of Winnipeg, Man., for $1,122, and to the Packard Electric Company, of Winnipeg, Man., for transformers, at $814. Contracts for the rest of the equipment will not be awarded at present.

CANANEA, SONORA, MEX.—Preparations are being made by the Greene-Cananea Mining Company for the installation of steam turbo-generating units with a rating of 3700 kw. A battery of eight large McDougall furnaces is being placed and a new reverberatory plant will be ready for operation within a few months.

New Industrial Companies.

THE CHAPMAN ENGINE & MANUFACTURING COMPANY, of Dundas, Ont., Can., has been granted a charter with a capital stock of $200,000. The company proposes to manufacture engines and machinery.

THE IMPERIAL VALLEY ELECTRIC COMPANY, of El Centro, Cal., has been organized with a capital stock of $10,000 for the purpose of manufacturing electric fixtures and doing a general electrical business. J. W. Frick is president of the company and C. F. Ferguson, secretary.

THE LUCK CEMENT POST MOLD COMPANY, of Aurora, Ill., has been incorporated with a capital stock of $40,000 by John G. Birtness, G. H. Klenze and E. W. Schoede.

THE MOHICAN ELECTRIC ALARM COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 to manufacture and deal in electric alarms, signals and supplies. The incorporators are: C. P. Bender, R. T. Ried, of Brooklyn, N. Y., and H. K. Bender, of New York, N. Y.

THE PRISMATIC ELECTRIC SIGN COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $2,000 by David A. Heidman, Julius and Oscar E. Epeneter and others.

THE TELEPHONE IMPROVEMENT COMPANY, of Attica, N. Y., has been incorporated with a capital stock of $3,000,000 for the purpose of manufacturing telephone supplies. The directors are: Frederick C. Stevens, of Attica, N. Y.; Charles H. North and James B. Hoge, of Cleveland, Ohio; Merton E. Lewis and Garrison Babcock, of Rochester, N. Y.; Wilslow M. Mead, of Albany, N. Y., and Alfred Stromberg, of Chicago, Ill.

THE WESTERN CARBON & BATTERY COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $50,000 by James A. Gorman, Ernest H. Stolton and John F. Gorman.

THE WILSON MOTOR CAR COMPANY, of Newark, N. J., has been incorporated by Samuel F. Wilson, John Foley, Jr., of 476 Clinton Avenue, Newark, N. J., and Gustave A. Lutz, of 17 Danforth Avenue, Jersey City, N. J. The company is capitalized at $50,000 and proposes to manufacture and deal in motors, engines, machinery, etc.

New Incorporations.

RED BLUFF, CAL.—The Mission Home Telephone Company has been organized to take over the business of the Pacific States Telephone & Telegraph Company for the Monterey Peninsula. The company will be capitalized at $100,000, and the amount paid to the parent corporation will be $40,000. Thomas J. Field, Arthur G. Metz, E. Cook Smith, Carmel Martin and George S. Gould, Jr., are interested in the new company.

HARRISBURG, PA.—Charters have been granted by the State Department to twelve power and illuminating companies to operate in Northampton, Monroe and adjoining counties as follows: The Washington Power Company, of Washington, Pa.; the Forks Power Company, Forks, Pa.; Palmer Power Company, of Palmer, Pa.; Hamilton Power Company, of Bangor, Pa.; East Stroudsburg Power Company, of East Stroudsburg, Pa.; Lehman Power Company, of Bangor, Pa.; Smithfield Power Company, of Stroudsburg, Pa.; Stroud Power Company, of Stroudsburg, Pa.; the Williamsburg Gas & Electric Company, of Williams, Pa.; the Palmer Gas & Electric Company, of Palmer, Pa., and the Forks Gas & Electric Company, of Forks, Pa. Each company is capitalized at $5,000 and the incorporators are: B. F. Cresson, T. F. McPherson and James W. Fox.

MONTROSE, PA.—The Montrose & State Line Railroad Company has been granted a charter with a capital stock of $150,000 for the purpose of constructing and operating an electric railway from Montrose to the New York and Pennsylvania State line, a distance of fifteen miles. The incorporators are: H. E. Paine, president; F. H. Widmyer, F. W. Ogden, W. J. Douglas, E. C. Randolph, T. P. Hamilton, Howard Fravel, H. J. Paine, of Scranton, Pa., and R. L. Koehler, of Dalton, Pa.

SCENERY HILL, PA.—The Marianna & Scenery Hill Telephone Company has been incorporated with a capital stock of $7,500 by J. W. Shiddler, S. G. Fulton and C. Woonsettler, of Marianna, Pa.

ELGIN, TEX.—The Elgin Telephone Company has been incorporated with a capital stock of $10,000 by L. J. Rivers, W. H. Rivers, Jr., and W. C. Rivers.

GREENVILLE, TEX.—A charter has been granted to the Greenville Railway & Light Company with a capital stock of $300,000 to construct and operate an electric railway, 3 miles in length, in Greenville. The incorporators are: S. A. Price, Albert Emanuel and H. L. Warner.

TACOMA, WASH.—Articles of incorporation have been filed for the Puget Sound, Chelan & Spokane Railway Company with a capital stock of $25,000,000. The company proposes to construct about 1200 miles of electric railway and to develop thirty hydroelectric properties in the State of Washington, aggregating more than 300,000 hp. The W. K. Palmer Company, 717 Dwight Building, Kansas City, Mo., has charge of the engineering work and will supervise the construction work.

Personal.

MR. E. H. ROSE, of Los Angeles, has been appointed manager at Martinez, Cal., of the Richmond Light & Power Company.

MR. CARL HERING will present a paper entitled "The Electric Furnace" before the Stevens Engineering Society on Feb. 14.

MR. GEO. E. HULSE, chief engineer of the Safety Car Heating and Lighting Company, will present a paper on "Illuminating Engineering" before the Stevens Engineering Society on April 4.

DR. K. G. FRANK, the American representative of Siemens & Halske, A. G., and Siemens Schuckertwerke, has moved his offices from 50 Church street, to the West Street Building, 90 West street, New York.

MR. W. GODFREY BOYD, JR., formerly with the sales department of the New York office of the Heany Lamp Company, has joined the sales department of the Lamont Corliss Company, 78 Hudson Street, New York.

MR. J. G. SWAIN has resigned as superintendent of light and power of the St. Joseph (Mo.) Railway, Light & Heat Company to become superintendent of motive power of the Cleveland, Painesville and Eastern Railway Company, Willoughby, Ohio.

MR. J. N. WALTON, electrical vehicle expert of the Edison Electric Illuminating Company, of Brooklyn, was married on Oct. 18 to Miss M. McMahan, of Brooklyn. After a honeymoon trip to Niagara Falls, the couple will take up their residence in Brooklyn.

MR. ALFRED W. BEUTTELL, of London, is on another visit to this country, where he will remain for some weeks. Mr. Beuttell will look over the electrical field with a view to arranging for introduction abroad of recently developed electrical apparatus or appliances.

MR. IRVING E. MOULTROP, engineer in charge of construction and installation for the Boston Edison Company, will present a paper entitled "The Design and Construction of a Central Power Station" before the Stevens Engineering Society at its meeting of Nov. 1.

MR. HENRY BOSCH, of the engineering department of the Pacific Gas & Electric Company, of San Francisco, is on a three-months tour of the country to study modern station construction and factory electric power applications. Mr. Bosch was a visitor at the New York Electrical Show.

MR. DANIEL NORRMAN, manager of the DeLaval Steam Turbine Company, of Stockholm, Sweden, is visiting this country for rest and recreation. Mr. Norrman has been a visitor to these shores many times, and is incidentally interesting himself in the development of electric heating and cooking devices.

MR. GEORGE BELL has resigned from the Westinghouse Electric & Manufacturing Company to accept the position of general manager of the Shelby County Water, Gas & Electric Company, with headquarters at Shelbyville, Ind. Mr. Bell, who has been connected with the Westinghouse company the past nine years, will assume his new duties on Nov. 1.

MR. C. A. TUPPER, who was for many years in charge of the sales promotion work of Allis-Chalmers Company, and who recently resigned to become manager of the Reliance Engineering & Equipment Company, is making his headquarters at Milwaukee, Wis., 1417-1419 Majestic Building, instead of in San Francisco, as originally contemplated. The change of plans was due to the labor troubles on the Coast.

MR. FRANCIS E. DRAKE, director-general of the Société Anonyme Westinghouse of Paris, has been promoted to the grade of officer in the Legion of Honor. Mr. Drake was in charge of American interests at the Paris Exposition of 1900, at the conclusion of which he received the decoration of Chevalier in the Legion of Honor, and his friends will note with pleasure this renewed mark of distinction on the part of the French government.

MR. E. H. MATHER has become associated with the bond department of Hayden, Stone & Company, bankers and brokers, of New York and Boston, as the expert in street railway, water power, gas and electric light securities. Until recently Mr. Mather has been general manager of the Nassau Light & Power Company, of Mineola, N. Y. He served his engineering apprenticeship with the old Thomson-Houston Company, remaining with the General Electric Company after the consolidation. In 1895 he left that company to become superintendent of the New Haven Street Railway Company. After similar connections with the Central Railway & Light Company, of New Britain, and the Portland Electric Lighting Company, of Portland, Me., he became in 1907 general manager of the Nassau company.

MR. T. R. TALTAVALL, for the past fourteen years associate editor on the staff of the *Electrical World*, has resigned that position to take the editorship of the *Telegraph and Telephone Age*, of which journal he becomes part owner. Mr. Taltavall began his editorial career in 1890 with his brother, Mr. John B. Taltavall, owner of the *Telegraph Age*, which property later was expanded into three journals by the publication from the same office of the *Telegraph Age*, *Street Railway News* and *Electrical Age*. Mr. Taltavall became editor of the latter journal upon its foundation and remained with it until 1896, when he joined the *Electrical World*. Previous to taking up editorial work, Mr. Taltavall

was one of the prominent telegraph operators of the country, and for several years prior to 1890 was superintendent of the leased-wire service of the Associated Press. In later years he has closely followed current advances in telegraphy, which branch he has cared for in these columns. The telegraph field is to be congratulated upon the enlistment of Mr. Taltavall's services, for, in addition to his personal ability and knowledge of the telegraphic art, he brings a broad journalistic experience for application in his new work. This journal will feel deeply the loss of Mr. Taltavall's collaboration, and personally his departure is a matter of keen regret to his associates, which is lightened only by the fact that his new connection will be highly advantageous from the financial standpoint.

Trade Publications.

MULTIPLE-UNIT.—This system is too well known to require any description here, but a new bulletin, No. 4761, just issued by the General Electric Company, should be of interest to railway men.

MILL TYPE MOTORS.—Bulletin No. 4754, issued by the General Electric Company, describes in considerable detail continuous-current and alternating-current motors for use in steel mills and similar places, in connection with cranes, hoists and other apparatus.

MOTORS FOR INDUSTRIAL APPLICATION.—A bulletin (No. 123) recently issued by the Crocker-Wheeler Company, of Ampere, N. J., describes a line of field-weakening, adjustable-speed motors for driving industrial machinery, and points out how economical results are obtained by their use.

BELT-TYPE GENERATORS.—An illustrated pamphlet (Bulletin 122) recently issued by the Crocker-Wheeler Company, of Ampere, N. J., contains much interesting information on the belt-driven generators, including the construction of the magnet frame, armature and commutator, the design and method of application of the field coils, the arrangement of the brush rigging, etc.

ELECTRIC DRIVE.—The Crocker-Wheeler Company, of Ampere, N. J., whose experience in motor drive extends over 23 years, has recently issued a bulletin (No. 120) on its Form I machine, which contains a large amount of useful information on direct-current motor design and is illustrated with half-tone cuts showing varied applications of these motors to machinery.

WESTINGHOUSE PERPETUAL CATALOGUE.—The Westinghouse Electric & Manufacturing Company has just made a distribution of sections for its perpetual catalogue No. 3001. The twenty-four sections in the new distribution cover a wide range of topics. Among the apparatus described are meters, circuit-breakers, arc lamp accessories, static protective apparatus, switchboards, transformers, series tungsten street-lighting systems, etc.

HIGH EFFICIENCY LAMPS.—With this title, the engineering department of the National Electric Lamp Association has reprinted, as Bulletin No. 9B, the paper presented by Mr. S. E. Doane at the St. Louis National Electric Light Convention, in which the effect is discussed of high efficiency lamps on the cost of light to central stations. The bulletin includes in addition reprints of a number of editorials commenting on the paper which appeared in technical journals.

POLYPHASE WATT-HOUR METERS.—The Thomson polyphase watt-hour maters, which are made for the specific purpose of measuring energy in any two-phase, three-phase, or monocycle circuit, are described in Bulletin No. 4762 of the General Electric Company. These meters may be applied to a circuit carrying a mixed load of lamps, motors or other translating devices, and are said to record accurately, irrespective of unbalanced load conditions.

LARGE MOTORS FOR STEEL MILLS.—Bulletin No. 4767, issued by the General Electric Company, illustrates and describes motors designed particularly for use in steel mills. Among them are the 6000-hp, 6600-volt induction motors recently installed in the Gary plant of the Indiana Steel Company. The bulletin refers to both alternating and direct-current motors, and contains instructions as to the data which should be furnished when making inquiries in connection with the installation of motors for such purposes.

PORTABLE SUBSTATIONS FOR ELECTRIC RAILWAYS.—In Bulletin No. 4746, published by the General Electric Company, is described a portable substation for the supply of energy intermittently to electric roads, and to provide for a temporary supply of energy in cases of accidents at substations equipped with only one rotary converter unit. This station consists of a specially arranged car containing a complete substation equipment and may be conveniently moved to any section of the line requiring energy temporarily.

SIGN LAMPS.—The enormous increase in the use of the electric sign is indicative of the increase in competition in connection with all branches of business, and proves that this method of advertising pays. In Bulletin No. 4758, published by the General Electric Company, there is described the highly efficient tungsten lamp, which has contributed and will contribute in still greater degree to the increase in this method of advertising. The bulletin contains a statement of the characteristics of the lamps, wiring diagrams showing the method of changing regular multiple sign wiring to series for sign lamps, and other wiring methods used with these lamps.

AUTO-TRANSFORMERS FOR LOW-VOLTAGE TUNGSTEN LAMPS.—Bulletin No. 4764 of the General Electric Company illustrates and describes a line of auto-transformers for low-voltage lamps. Low-voltage lamps may be used to advantage where small units of light are employed, or in connection with gasoline-engine-driven generating sets, and particularly where the lamps are frequently moved about and subjected to jars. They are also used in connection with ornamental street lighting, and when so used are operated on the standard multiple circuit in connection with an auto-transformer, which is installed in the base of the pole. The bulletin contains data relative to the cost of operating these lamps and shows a diagram of connections.

REMEK TRANSFORMERS.—In the Hungarian language Remek means masterpiece. A line of lighting transformers has recently been placed before the public by the Crocker-Wheeler Company, of Ampere, N. J., to which this name has been applied, and which are radically different in design from any others on the market at the present time. In this machine very low average core-loss and high average efficiency are said to have been effectually combined with many other desirable features. These results are obtained largely through new and original features embodied in the design. The descriptive bulletin (No. 125) which the Crocker-Wheeler Company has published on this subject contains much information of special interest to lighting transformer users.

BUSINESS NOTES.

JAMES BEGGS & COMPANY will move to 35 Warren Street, New York, on Nov. 1.

AMERICAN ELECTRIC FUSE COMPANY.—Mr. Fred B. Bonde has opened temporary offices at 202 Medinah Temple, 185 Jackson Boulevard, Chicago, Ill., where he will represent the American Electric Fuse Company, of Muskegon, Mich. He will have on hand a complete stock of telephone protector apparatus, rheostats, motor starters, controllers, spark coils and enameled wire.

INDUCTION FEEDER REGULATORS.—Among the large orders that the Westinghouse Electric & Manufacturing Company has recently entered for automatic induction feeder regulators is one for 58 from the West Penn Railways Company, and another for six 100-kw and two 200-kw from the Detroit Edison Company. These regulators will be used on power and lighting circuits.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, Philadelphia, was an exhibitor at the recent convention of the Association of Railway Electrical Engineers in Chicago. It displayed several types of I-T-E circuit-breakers. Type "W," designed for train lighting and motor use, was demonstrated by C. E. Wise, of the Chicago office. H. F. Darby, Jr., also represented the company.

THE WISCONSIN ENGINE COMPANY has received a contract for three horizontal, cross-compound, condensing Corliss engines for the Tidewater Portland Cement Company, at Union Bridge, Md., to be direct-connected to 925-kw, 3-phase, 60-cycle alternators. These engines will be furnished with the special valve gear, cylinders and governors peculiar to the "higher speed" Corliss engines built by the Wisconsin Engine Company, and will be designed for particularly economical performance and close regulation on a variable load.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 11, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

13,157. LAMP RECEPTACLE; H. W. Lawrence, Denver, Colo. App. filed Aug. 26, 1909. A sheet metal threaded cell supported by a porcelain base for use on moldings, including an insulated wall in the body and a terminal plate surrounded by the wall and a threaded shell surrounding the wall.

972,209. SWIVELING ATTACHMENT FOR ELECTRICAL APPARATUS; J. H. Morley, Johnstown, Pa. App. filed June 26, 1909. For suspending incandescent lamps or receivers for telephone including a terminal plug with arc shaped terminals at the side and U-shaped springs at the end and a metal sleeve abutting the other end and surrounding the plug and contacting with the arc shaped terminal at the side.

972,216. STORAGE BATTERY CIRCUIT CONTROLLER AND TESTER; H. N. Motsinger, Pendleton, Ind. App. filed Feb. 9, 1909. A generator, storage battery, meter circuit and three terminal switch blocks for testing the voltage of either the generator or storage battery and for connecting the generator so as to charge the battery.

972,240. TROLLEY; H. B. Potts, Jackson Township, Ohio. App. filed Jan. 10, 1910. A trolley harp with a hollow body for the end of the pole connected to the harp by a bolt constituting a pivot so as to enable the wheel to follow the wire.

972,248. ELECTRIC HEATING RECEPTACLE; W. Richmond, Memphis, Tenn. App. filed Feb. 13, 1909. A switch and thermostat and resistance wires between the outer and inner walls of the receptacle.

972,267. PIGTAIL CONNECTION FOR CARBON BRUSHES; W. Shaw, Lakewood, Ohio. App. filed June 5, 1909. The brush is perforated transversely and receives a socket, and a hole is located in the body of the brush for receiving the cable end, and the cap screw secures the socket in place.

972,308. ELECTRIC HEATER FOR OIL WELLS; J. E. Williamson, Pittsburgh, Pa. App. filed Oct. 26, 1908. A pumping tube and heater, the latter including an outer and inner shell and an electric resistance on the exterior of the inner shell, the latter shell being the return conductor and the resistance being in a water-sealed chamber between the shells, the inner shell being connectible to a pumping tube.

972,329. LOCK-OUT DEVICE FOR PARTY LINE TELEPHONES; W. M. Bruce, Jr. App. filed July 9, 1906. A relay at the subscriber's station which, when the telephone is taken off the hook, is bridged across the line and switches into the circuit the subscriber's talking outfit, the construction being such that the talking instruments of the relay utilize the current flowing on the line so that the relay at another station is not operated when the telephone hook at the subscriber's station is in operative position.

972,343. LAMP SOCKET; J. Darby, Summit, N. J. App. filed Feb. 3, 1909. For lamp sockets with pole switch attachment, the controlling member having separable parts of insulation about a center, each carrying a conductor, the parts fitting into each other to rotate together with large clearances between the branches for insulation.

972,353. FIRE ALARM SWITCH; P. W. Eskridge, Rutherfordton, N. C. App. filed June 9, 1909. A swinging frame which moves into engagement with a pair of contacts forming part of a fire alarm system, like a spring pressed trap.

972,362. FUSE SUPPORTING CONNECTION; E. L. Grauel, Troy, N. Y. App. filed Feb. 8, 1910. Metallic lugs screw threaded and yielding supported conductors contacting with the lugs.

972,365. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed Apr. 25, 1908. An electric switch with a frame, spindle, pole plate and two push buttons connected with the escape plate with a locking flange, a hub, radial arms and pins and lugs on the arms cooperating with the flange.

972,387. SNAP SWITCH; S. A. Koltonski, Boston, Mass. App. filed Oct. 26, 1906. A switch with a base having an aperture with an annular shoulder, a bonding post with a shank extending through the aperture and having an enlarged end and a strain receiving annular member of non-yielding material surrounding the shank.

972,209. — Swiveling Attachment Device for Electrical Apparatus.

972,399. ATTACHMENT FOR TELEPHONES; J. W. Nilsson, Balfour, North Dakota. App. filed Nov. 16, 1909. An audible signal which gives the alarm when another person on the party line is using the system, including the receiver fork, with means for setting the mechanism upon the depression of the fork and elements arranged to prevent a second depression of the fork until the signaling mechanism has completed its operations.

972,424. ELECTRICAL RELAY; L. A. Williams, Lynn, Mass. App. filed July 16, 1909. Spring contact telephone relay, including a magnet, a frame, a lever armature with a rolling or shifting fulcrum.

972,457. ELECTRICALLY PROPELLED VEHICLE; W. Kohler, Bremen, Germany. App. filed May 17, 1910. Trackless vehicle propelled from overhead wires with a guide pipe pivoted to the vehicle and a lever near the driver for swinging the pipe.

972,468. CLOSED SYSTEM OF ELECTRICAL DISTRIBUTION; R. M. Palmer, Cambridge, Mass. App. filed Mar. 1, 1909. The lamp circuit is normally closed and the supply circuit normally open, the latter being used for ringing bells and being connected to the former through a portion of its resistance.

972,489. GROUND CLAMP; H. E. Adams, Toledo, Ohio. App. filed June 28, 1909. Clamps which surround the pipe by means of a band and saddle, being secured thereto by a setscrew.

972,514. DEVICE FOR BRAKING TRAMCARS AND ELECTRIC RAILWAY CARRIAGES; C. Degoumois, Berne, Switzerland. App. filed June 20, 1908. The motor is short-circuited and a series of resistances and a series of keys are provided, including a metal band carried by a shaft independent of that for starting the motor which withdraws the resistances progressively from the short-circuit as the shaft is turned.

972,516. ELECTRIC SIGN FLASHER; R. D. DeWolf, Pittsburgh, Pa. App. filed Nov. 30, 1906. A tilting casing containing a fluid with a partition dividing the casing into two compartments and having an opening to retard the flow with a contact in each compartment and electro magnets for tilting the casing.

972,526. ADJUSTABLE CASING FOR LAMP SOCKETS; E. H. Freeman, Trenton, N. J. App. filed July 28, 1910. A cap with lugs having locking shoulders and a shell with positioning slots and a locking abutment at one end and an inturned guiding lip engaged by one of the lugs as the other lugs enter the positioning slots.

927,536. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 8, 1906. A main generator, a regulating battery with means for varying the current controlled by a movable member and a pair of constantly rotating motors, one having two field windings acting cumulatively and the other two field windings acting differentially with mechanical connections between the motors and the differential gearing connected to the rheostat of the booster.

972,538. MAXIMUM DEMAND METER; V. Karapetoff, Ithaca, N. Y. App. filed Nov. 9, 1907. A watt meter with means for indicating the maximum power demand during the given interval connected thereto by a friction clutch and and electromagnet which restores the means to initial position and releases the clutch, the pointer being settable so as to impose a penalty for using power in excess.

972,542. MERCURY SWITCH; H. Koch, Rahway, N. J. App. filed Sept. 11, 1908. Switch containing mercury with two socket terminals closed by caps that are perforated and receive the switch pins.

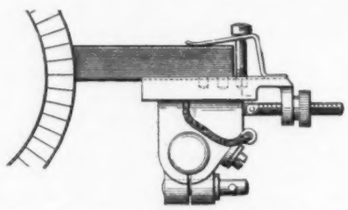
972,577. ELECTRICAL FIXTURE; F. E. Seeley, Bridgeport, Conn. App. filed June 17, 1909. Pendent socket with separable members, one member recessed and the other having a projection tending to enter the recess, the wire being bent into a U-shape over the projection so as to take the strain.

972,625. MOTOR CONTROLLING APPARATUS; S. H. Keefer, Plainfield, N. J. App. filed July 23, 1909. Starting and reversing switch with an arc blow-out including a solenoid with a core and a series of contacts on the core, normally out of engagement with each other, but contacting when the solenoid is energized and a resistance to different points of which the contacts are connected.

972,628. CENTRAL TELEPHONE SYSTEM; A. D. T. Lubbey, Elyria, Ohio. App. filed May 28, 1909. Three conductor cord type in which the third conductor is independent of the talking conductors with a signaling current and a pair of supervisory relays controlling the signal source, one of the relays being connected in the circuit independently of the conversation circuit.

972,634. ELECTRICAL RELAY; C. H. North, Cleveland, Ohio. App. filed Nov. 13, 1908. Telephone switch relay with long contact springs, an operating lever and a short armature working on a small air gap so as to multiply the movement produced by the armature.

972,655. BRUSH-HOLDER FOR ELECTRIC CONDUCTORS; F. L. Sessions, Columbus, Ohio. App. filed March 8, 1902. A brush



972,655.—Brush Holder for Electric Conductors.

secured to its support by a resilient clamp which may be adjusted longitudinally of the support.

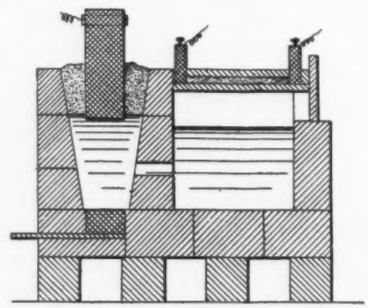
972,660. ELECTRICALLY OPERATED BLOCK SIGNAL MECHANISM; R. A. Streeter, Marion, Ia. App. filed June 24, 1908. Upper quadrant signal operated by an electric motor and gearing and chain connection.

972,675. APPARATUS FOR LIGHTING MINERS' SAFETY LAMPS; J. C. Bowie, Cardiff, England, and J. H. Phelps, Yokohama, Japan. App. filed July 11, 1908. A dynamo and lamp-holding receptacle tightly closed by a lid with a lid-locking arm and rod between the arm and the driving means for the dynamo, the driving means being released or locked by a pawl held in engagement by a spring, the pawl being connected with the connecting rod.

972,682. ELECTRICAL INDICATOR; E. E. Craig, Kansas City, Mo. App. filed June 16, 1909. An electric selector switch with a circular series of contact segments each with a rise on its end and a rotary switch lever carrying a yielding roller engaging the segments.

972,715. TELEPHONE RECEIVING APPARATUS; G. W. Pickard, Amesbury, Mass. App. filed Mar. 16, 1910. For wireless telegraphs and telephones in which a spark terminal is connected with the magnet and pole piece system of a receiver.

972,721. WIRELESS TELEGRAPHY OR WIRELESS TELEPHONY; O. Rochefort, Paris, France. App. filed Nov. 8, 1909. Receiver system consisting in arranging four detectors forming rectifiers so as to arrange between the earth of the bi-polar resonator and the ends of the circuit of the telephone receiver a condenser with three contacts.



972,779.—Electric Furnace for the Continuous Manufacture of Glass.

972,778. ELECTRIC FURNACE FOR CONTINUOUS MANUFACTURE OF GLASS; M. Sauvageon, Colombes, France. App. filed Aug. 2, 1910. Electrodes are immersed in the molten glass at the ends of the chamber so as to confine the current to the melting and refining chamber, a working chamber receiving the refined glass.

972,779. ELECTRIC FURNACE FOR CONTINUOUS MANUFACTURE OF GLASS; M. Sauvageon, Colombes, France. App. filed Aug. 5, 1909. A combined melting and refining chamber of small capacity, a lower electrode at the bottom, an upper electrode, the glass when molten constituting a heating resistance, and a working chamber to receive the refined glass.

972,782. SYSTEM OF ELECTRICAL DISTRIBUTION; J. B. Entz, Philadelphia, Pa. App. filed May 28, 1904. A main battery with pilot cell, the pilot cell first becoming charged with means for opposing the effect of the main battery and the pilot cell with a switch for interrupting the circuit through the main battery.